BIENNIAL OPERATIONS AND MAINTENANCE ASSESSMENT (O&M) REPORT
GROUNDWATER REMEDIATION SYSTEM
FORMER AT&T RICHMOND WORKS FACILITY
JUNE 2017 TO MAY 2019

Report Prepared for:

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August 2019

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EXECUTIVE SUMMARY

AT&T and subsequently Lucent Technologies (Lucent) formerly owned and operated a manufacturing facility at 4500 Laburnum Avenue in Richmond, Virginia (Richmond Works or Site). The former Richmond Works facility was previously used for the manufacture of printed circuit boards including electrolysis/electroplating, etching and coating processes. In 1986, chlorinated volatile organic compounds (VOCs), primarily consisting of 1,1,1-trichloroethane (TCA) and methylene chloride (MEC), were identified in soil at the solvent tank farm and solvent recovery area associated with the manufacturing facility. Subsequently, the U.S. Environmental Protection Agency (EPA) Record of Decision (ROD) dated June 28, 1991, required groundwater remediation with specified cleanup goals at specified points of compliance for MEC (5 micrograms per liter [µg/L]); TCA (200 µg/L); 1,1-dichloroethene (DCE, 7 µg/L); and 1,1-dichloroethane (DCA, 4 µg/L); the latter two being breakdown products of TCA. These are constituents are considered contaminants of concern (COCs). As required by the ROD, a groundwater pump and treatment system (GWTS) was installed in February 21, 1995, and currently consists of 18 extraction wells including 4 dual-phase extraction (DPE) wells. The manufacturing operations were shut down in June 2001.

The system was upgraded between 1999 and 2001 to increase groundwater removal efficiency and enhance hydraulic control. The upgrades included the installation of one source-area and five perimeter extraction wells, along with the installation of a DPE system for vacuum-enhanced recovery of groundwater at four extraction wells within the source area. Eleven off-site monitoring wells were also installed to more accurately delineate the extent of the plume.

The GWTS and property have had different ownership over the years. LSI Corporation (LSI) was acquired by Avago Technologies in May 2014. Effective February 1, 2016, Avago Technologies acquired Broadcom Corporation to form a new company "Broadcom Limited." In April 2018, Broadcom Limited was redomiciled in the United States as "Broadcom Inc.". LSI, currently owned by Broadcom Inc. (Broadcom), and Alcatel-Lucent USA, Inc. (Alcatel) maintain responsibility for the 2013 Administrative Order, and the GWTS at the former AT&T Richmond Works. However, the property itself was developed by Forest City Commercial Development, Inc. (Forest City) into the White Oak Village Shopping Center between 2006 and 2008. As part of the site development, Forest City subdivided parcels of the property and sold them to individual retail/development entities. During site redevelopment, existing underground utilities were upgraded, and additional underground utilities were added to support activities at the White Oak Shopping Center. The majority of White Oak Village Shopping Center is currently owned by BRE DDR White Oak Village LLC and SITE Center Corp of Ohio.

On March 4, 2013, the EPA issued a final Administrative Order to replace the former order with Lucent. LSI and Alcatel are both listed as respondents on the new order. The new order required LSI to implement institutional controls (ICs) for the site, along with the submittal of revised versions of the Health and Safety Plan (HASP) and O&M Plan for the groundwater treatment system. Updated HASP and O&M Plans were submitted, and LSI established environmental covenants with applicable property owners. The ROD, along with the corresponding Administrative Order, requires the preparation and submittal of Biennial O&M Assessment Reports (Biennial Report).

This Biennial Operations and Maintenance Assessment Report summarizes the performance of the groundwater remediation system at the Richmond Works facility during the period from June 2017 to May 2019, under the 2013 Administrative Order. This report provides information regarding hydraulic control of the contaminant plume and the contaminant removal efficiency of the GWTS with respect to cleanup goals in the ROD. It also includes a summary of work performed as described in the Interim Next Steps of the August 2017 Biennial Report. The GWTS was operational from June 2017 through May 2019, therefore, weekly routine inspections of the GWTS and associated repairs and maintenance were conducted as required.

From June 2017 to May 2019, groundwater sampling was performed as outlined in the ROD (ROD sampling) in November/December and in May. In addition, a subset of monitoring wells, typically about 30, were sampled in February and August described to the Interim Next Steps of the August 2017 Biennial Report. Quarterly monitoring in this manner continues to the present.

Building upon the soil assessment activities completed in 2017 and discussed in the August 2017 Biennial Report, additional soil assessment was performed in October 2018 to further delineate impacted source area vadose zone soil that may be contributing to the mass transfer of contaminants to groundwater and a resultant ongoing degradation of groundwater quality.

The 2018 soil assessment, contaminant trends, and GWTS operations for the reporting period are summarized in the paragraphs below.

Soil Assessment

From October 22-24, 2018, Wood mobilized to the Site to evaluate potential contributions from source area vadose zone soil impacts to groundwater by collecting soil samples near the former manufacturing facility and beneath the underground concrete pads. The soil samples were collected from borings advanced with a Geoprobe ® using direct push methods and located based on historical reports provided by EPA and the consultant of the developer, Partners Environmental Consultants, Inc. A total of 37 soil borings were advanced and soil samples from the borings were field-screened for volatile organic vapors. To verify total field results, 37 soil samples were sent to Air, Water, and Soil Laboratories, Inc. for analysis of VOCs according to SW Method 8260B.

Additionally, two groundwater samples were collected during this soil assessment at locations below each underground concrete pad to obtain an understanding of potential groundwater impacts. PVC pipe was installed within the two boring locations as a temporary well and groundwater samples were collected into laboratory-provided containers using a waterra check valve and tubing and sent to Air Water, and Soil Laboratories, Inc. for analysis of VOCs according to SW Method 8260B. Groundwater results from these two locations may be different if collected from a permanent monitoring well, therefore, the groundwater results are used for comparative purposes only.

A soil assessment was also performed in 2017 and reported in the previous Biennial Report. The 2018 assessment refined work performed in the 2017 assessment, so for overall clarity, the following paragraphs summarize observations of the 2017 and 2018 soil assessments:

- Constituents such as TCA, MEC, and 1,4-dioxane are present at substantially elevated concentrations in the vadose zone near the locations of factory buildings (Buildings 51 & 33) and the Tank Farm. Because these constituents are not degradation products, but instead were present in chemicals used in the manufacturing process and are found close to historical manufacturing activities, these high concentrations indicate historical releases and a primary source of impacts to groundwater rather than a result of matrix effects.

- The impacts, particularly beneath the concrete pads, extend from depths of approximately 7 feet below land surface to the depth of the groundwater-soil interface or smear zone.

- Groundwater impacts beneath the concrete pads are the highest total VOC concentrations measured at the Site to date.

- Clay is the predominant soil type from the land surface to the depth of groundwater at approximately 15 to 20 feet below land surface. Particularly in areas of historically high COC concentrations in groundwater, it is possible that VOCs have been introduced to previously unimpacted areas of clay along the groundwater interface, creating "matrix effects" where the clay provides a continual source of residual VOCs to groundwater over larger areas of the site. This matrix effect may be contributing to the stable mass of VOCs remaining in the groundwater year after year <u>and is a separate condition from vadose zone soil that has been impacted as a direct result of a release.</u>

To target the vadose zone with the greatest mass and representative of a release, areas were identified that meet the following criteria: 1) concentrations of TCA, MEC and 1,4-dioxane, (constituents of manufacturing chemicals used in the manufacturing process) that are 100 times the EPA Protection of Groundwater Site Screening Levels or greater, 2) located beneath former structures, 3) located beneath concrete pads, and/or 4) believed to be void of utilities (**Figure 3**). Target concentrations at 100 times the EPA Protection of Groundwater Site Screening Levels are 28,000 μg/kg for TCA, 270 μg/kg for MEC and 9.4 μg/kg for 1,4-dioxane. According to the EPA's *Soil Screening Guidance: Technical Background Document* (EPA, 1996), EPA Protection of Groundwater Site Screening Levels are estimated based on a dilution factor of the Maximum Contaminant Levels that estimates the concentration of soil leachate that could conservatively impact groundwater. Wood is not targeting all areas of soil that could possibly impact groundwater. For example, Wood is not targeting areas of lower-concentration soil that may re-contaminate groundwater due to matrix effects, but only areas of high vadose zone soil concentrations likely resulting directly from historical releases. Groundwater results will be summarized in the following section.

Contaminant Trends

Historical contaminant information for surface water and groundwater are provided for sampling events from 1989 to the present. However, isoconcentration maps and graphical presentation begins in 2000 at the latest and prior to re-development as discussed in a May 2017 teleconference with EPA. Wood performed trend analysis on monitoring results using the GSI Mann-Kendall Toolkit. Generally, when trends are discussed, the trend analysis is performed from the beginning of Work Plan implementation in January 2016 to the last date the well was sampled except where otherwise noted.

Contaminant trends using Mann-Kendall Trend Analysis for this reporting period (June 2017-May 2019) can be summarized according to results from surface water (SW15, SW21, and SW67), compliance monitoring wells (MW10, MW17, MW28), and contingency monitoring wells (MW50, MW51, MW53, MW54, MW55, and MW56):

- Surface Water: After April 2012, VOC concentrations appear stable inclusive of this reporting period.

- Compliance Points: According to the Mann-Kendall Trend Analysis, Total VOC concentrations are "decreasing" in MW17 and MW28. Total VOC concentrations in MW10 are "no trend". However, vinyl chloride concentrations are increasing in MW10 suggesting anaerobic abiotic/biotic degradation may be occurring near MW10. MW10 is located near the sanitary sewer line along the centroid of the site. It is possible that the total organic carbon leaked from the sanitary sewer is aiding in the biodegradation of TCA. TCA concentrations in MW10 are "probably decreasing".

- Contingency Points: Groundwater or surface water contingencies developed with the 2016 Work Plan <u>were not exceeded</u> for the contingency monitoring points, so the contingency was not activated during this reporting period. However, DCE is near the contingency value of 150 µg/L in MW51. Mann-Kendall Trend Analysis also suggests that COCs and VC and 1-4 dioxane in contingency wells are stable since at least October 2016.

When considering the plume in general and according to Mann-Kendall Trend Analysis, <u>Total VOC concentrations</u> in the core zone of groundwater impacts (MW6, MW7, MW8, MW10, MW11, and MW13), transition zone (MW2, MW3, MW4, MW5, MW9, MW14R, MW15R, MW16, MW23, MW26, MW28, MW29, and MW33), and perimeter zone (remaining wells) generally exhibit a "stable/no trend" with the following exceptions:

- Core & Transition: Concentrations in core monitoring wells MW7 and MW8 and transition monitoring wells MW4, MW16, compliance point well MW28, MW29, and MW33 showed "decreasing" Total VOC trends.

- Core & Transition: MW2, MW3, and MW5 exhibited "increasing" Total VOC concentrations since November 2015 possible due to their location in the vicinity of the vadose source area identified in 2018 beneath the concrete pads under the mall road (e.g., MW2, MW3, and MW5. Note that record rainfall occurred in 2018 and may have contributed to increased concentrations through infiltration or potentially leaky storm water lines that are located along the mall road. Total VOC concentrations in MW14R, and MW23 are also increasing. However, concentrations are below the clean up values with the exception of DCE in MW14R.

- Perimeter: West side perimeter wells MW25 and MW35 show "increasing" Total VOC concentrations. Total VOC concentrations appear to stabilize in MW35 around November 2016 while Total VOC concentrations do not appear to be stable in MW25 since November 2015. Total VOC concentrations appear to fluctuate seasonally between "stable/no trend" and "increasing" in MW36.

- Perimeter: North side perimeter well MW51 shows "increasing" Total VOC concentrations since January 2016. However, Total VOC concentrations in MW51 appear to have been stable since at least October 2016.

It is apparent that natural attenuation with an abiotic/biotic component has been integral in the reduction of groundwater contamination at the site, and that natural processes have continued to supplement the removal of COCs at the Site. Natural attenuation continues to be indicated by the presence of the degradation products of TCA, which can be accounted for by natural processes, including the reductive dehalogenation of TCA in the subsurface. These products include DCA, DCE, chloroethane, and vinyl chloride; the latter two from the breakdown of DCA and DCE. Specifically, reductive dechlorination appears to be occurring near the sanitary sewer line as evidenced by the production of VC that occurs at that location.

As an example, historically low nitrate (<0.07 mg/L) and sulfate concentrations (12.3 mg/L) from samples collected in May 2017, and negative oxidation reduction potentials (-204.8 to -21.2 mV) and low dissolved oxygen concentrations (0.10 to 1.85 mg/L) over this reporting period have been observed in MW16 located near the sanitary sewer line suggesting the potential for reductive dechlorination. Groundwater samples were collected from MW16 and MW33 during the August 2017 Biennial reporting period (e.g., August 2016) and submitted to Microbial Insights for qPCR DNA analysis for Dehalobacter spp. and Dehalococcoides spp. Dehalobacter containing culture[1] have been shown to be involved in the biodegradation of TCA through DCA to chloroethane. Dehalobacter spp. (1.04X 10^1cells/mL) was detected at low concentrations and chloroethane was

[1] Microbial Insights Website, http://www.microbe.com/chlorinated-ethanes-census

detected in MW16 suggesting that anaerobic biodegradation is occurring in the vicinity of MW16 and may be enhanced with the addition of an electron donor.

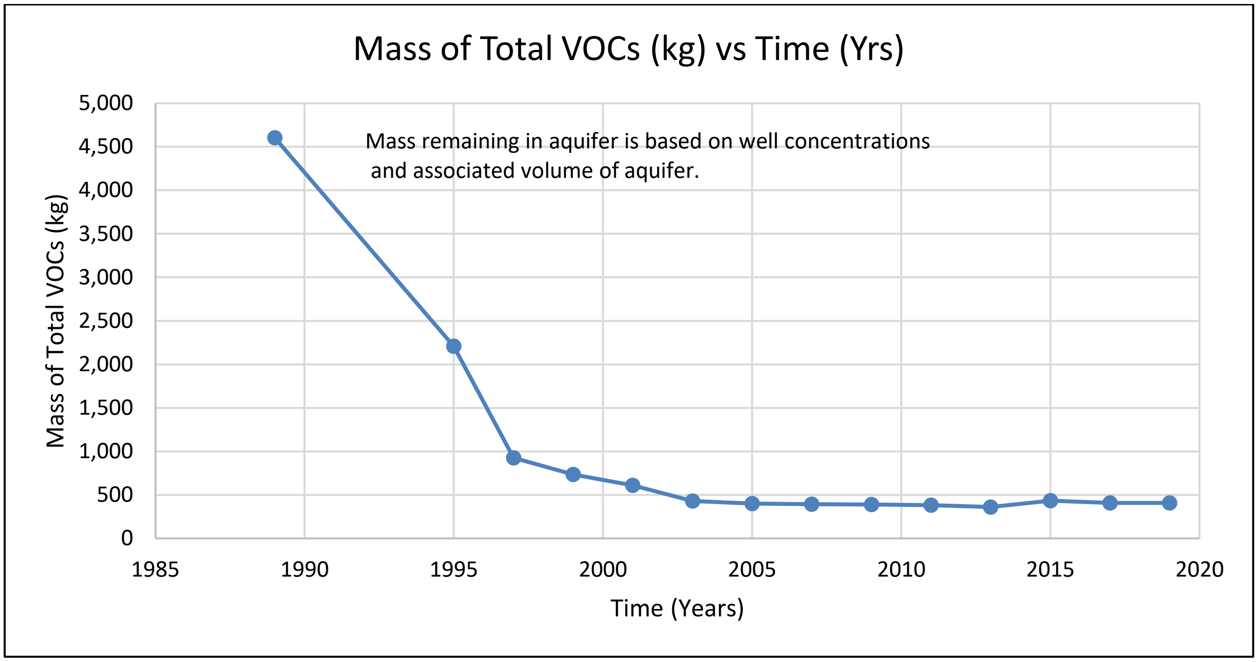
Additional evidence of abiotic/biotic mechanisms is supported by Mann-Kendall Trend Analysis showing a "decreasing" Total VOC concentration trend in MW7 and MW28 via "decreasing" concentrations of TCA with simultaneously "increasing" concentrations of DCA, a biodegradation product.

In addition to abiotic/biotic mechanisms, review of recent information regarding the aerobic degradation of 1,4-dioxane and TCA suggest that the aerobic degradation of 1,4-dioxane may be possible in certain areas onsite apart from other areas of the site where anaerobic respiration appears to be occurring. Most recently, the co-metabolic transformation of 1,4-dioxane has been observed in microorganisms that express the ability to use methane and toluene as growth supporting substrates. Because biodegradation is partially dependent on the geochemistry, the presence of organisms, and contaminant concentrations, groundwater samples from EW15 and MW34 were submitted to Microbial Insights in February 2018 for CENSUS® qPCR DNA analysis to quantify contaminant degrading microbes through functional genes and assess the potential for aerobic biodegradation of 1-4 dioxane. Although the groundwater is not saturated with dissolved oxygen near EW15, the dissolved oxygen concentrations appear moderate (5.40 mg/L) and has the potential to support microorganisms capable of co-metabolizing 1,4-dioxane.

Overall, the aerobic biodegradation of dioxane is possible near EW15 likely utilizing methane oxidizing bacteria that produce enzymes that area capable of co-metabolizing dioxane. In addition, it may be possible to bioaugment the groundwater in the vicinity of EW15 with a consortium of microorganisms capable of enhancing the co-metabolism of 1,4-dioxane as well as TCA and associated daughter products. On the contrary, none of the functional genes were detected in the MW34 groundwater sample, and so, aerobic biodegradation does not appear likely near MW34.

GWTS Operations

Based on a review of historical and recent GWTS performance, approximately 4,603 kilograms (kg) of total VOCs were estimated to be present in the aquifer prior to system start up in 1989. As of May 2019, approximately 409 kg of total VOCs remain in groundwater, suggesting that a total of 4,194 kg of total VOCs have been removed from the groundwater since 1989 by the GWTS, dilution, and biotic/abiotic mechanisms. This represents a 91% reduction in total VOCs. After the discovery of newly identified mass in vadose zone soil in 2017 and 2018, and total VOCs in groundwater in excess of 100,000 µg/L beneath the concrete pads, the amount of mass remaining in the groundwater was revised to include the additional mass identified. Despite the operation of the GWTS for over 20 years, the amount of mass remaining in the aquifer has remained largely stable even though the GWTS system has removed an average of 80 kg per reporting period since 2009 along with mass removal efficiency (kg removed/Mgal pumped) having increased at least two-fold since 2013. This may be partially attributed to the "matrix effects" and potentially due to the movement of VOC mass from vadose zone soil beneath the concrete pads and tank farm area into groundwater providing for the continuing degradation of groundwater quality.



Prior to 2010, historical groundwater flow was consistently south to north across the site; since 2010, the flow has been generally southeast to northwest. Groundwater mounding along the western property boundary seems to limit groundwater flow to the west. This change in historical groundwater flow direction could potentially be influenced by the stormwater detention pond located in the northeast corner of the site installed during redevelopment.

In 2003, the EPA and Agere Systems (spin-off company of Lucent Technologies before merging with LSI in 2007) worked together to further delineate the leading edge of the groundwater plume. This effort culminated in the activities described in the Updated Work Plan for Groundwater Sampling and Analysis (original date April 8, 2003, revised date July 14, 2003). The data from this reporting period delineated the leading edge of the plume, and the leading edge of the plume is similar to that of previous years.

When the GWTS was relocated during Site redevelopment, upgrades and/or replacements of all major treatment system components (with the exception of the programmable logic controller) occurred. While these upgrades have served to reduce maintenance requirements and further minimize system downtime, the general age of the system and iron fouling continue to be the source of operational issues that occurred over the reporting period, and will likely continue to be an important consideration in the future operation of the GWTS. In addition, and as a result of the changes to underground site utilities during Site redevelopment, preferential pathways were enhanced or created along the pipe bedding of the underground utilities.

The movement of water along the preferential pathways appears dependent on the amount of rainfall where increased rainfall causes mounding in the center of the site where groundwater concentrations are high due to infiltration and numerous utilities which may transfer water to the area via pipe bedding or leaky piping (e.g., stormwater sewer or sanitary sewer). Record rainfall occurred in Richmond in 2018 with 63.73 inches reported by the Richmond International Airport. This mounding appears to push water along the preferential pathways to the west and occurs somewhat seasonally. Once impacted groundwater reaches the western perimeter, it appears to move along the utility corridor to the north, and pool in the vicinity of MW25 contributing to increasing concentrations in that area. However, after the groundwater pools at MW25, the natural groundwater flow conditions appear to re-establish.

Recommendations

A Technical Memorandum is currently being prepared to propose the "Next Steps" for the LSI Site, and will be delivered under a separate cover. However, Wood recommends the following interim steps while the Technical Memorandum is prepared.

- Since Total VOC concentrations are generally "Stable/No Trend" east of the sanitary sewer line running to the north, we recommend extraction wells EW4, EW5, EW6, EW7, EW8, EW11, EW12, and EW17 remain out of service to avoid moving contaminants to the east.

- Continue quarterly monitoring as described in the 2017 Biennial Report and described in **Table 1** for calendar year 2018. It is also recommended that MW2 and MW5 be sampled semi-annually instead of annually.

1.0 INTRODUCTION AND BACKGROUND

AT&T and subsequently Lucent Technologies (Lucent) formerly owned and operated a manufacturing facility at 4500 South Laburnum Avenue in Richmond, Virginia (Richmond Works or Site). In February 2001, Agere Systems (Agere), the former Microelectronics Group of Lucent, assumed the responsibility for groundwater remediation at the facility. LSI Corporation (LSI) subsequently purchased Agere in early 2007 and thereby assumed groundwater remediation responsibility. Avago Technologies Limited purchased LSI Corporation on May 6, 2014, and subsequently, effective February 1, 2016, Avago Technologies Limited acquired Broadcom Corporation to form a new company "Broadcom Limited." In April 2018, Broadcom Limited was redomiciled in the United States as "Broadcom Inc.".

This report uses "LSI" when referring to the ownership entities of the groundwater pump and treatment system (GWTS).

The large-scale storage and use of methylene chloride (MEC) and 1,1,1-trichloroethane (TCA) at this facility was discontinued in 1989, when it was discovered to have contributed to the contamination of the shallow groundwater table. Subsequently, the U.S. Environmental Protection Agency (EPA) Record of Decision (ROD) dated June 28, 1991, required groundwater remediation with specified cleanup goals for MEC (5 micrograms per liter [µg/L]); TCA (200 µg/L); 1,1-dichloroethene (DCE, 7 µg/L); and 1,1-dichloroethane (DCA, 4 µg/L); the latter two being breakdown products of TCA. In summary, the contaminants of concern (COCs) include DCA, DCE, MEC, and TCA while the contaminants of interest (COIs) include vinyl chloride (VC) and 1,4-dioxane. The GWTS has been operating at the facility since February 21, 1995, and AECOM (formerly Earth Tech) was the Operations and Maintenance (O&M) contractor for the GWTS from 1998 until 2013. In 2013, Wood Environment & Infrastructure Solutions, Inc. (Wood; formerly Amec Foster Wheeler) was hired to operate and maintain the existing GWTS and simultaneously, evaluate and update the approach to remediation at the site.

The GWTS and property have had different tracks of ownership over the years. LSI, currently owned by Broadcom Inc., and Alcatel-Lucent USA, Inc. (Alcatel) maintain responsibility for the current Administrative Order, and the GWTS at the former Richmond Works facility. However, the property itself was developed into the White Oak Village Shopping Center between 2006 and 2008. As part of the site development, Forest City subdivided parcels of the property and sold them to individual retail/development entities. During site redevelopment, existing underground utilities were upgraded, and additional underground utilities were added to support activities at the White Oak Shopping Center. The majority of White Oak Village Shopping Center is currently owned by BRE DDR White Oak Village LLC and SITE Center Corp of Ohio.

On March 4, 2013, the EPA issued a final Administrative Order to replace the former order with Lucent. LSI and Alcatel are both listed as respondents on the new order. The new order required LSI to implement institutional controls (ICs) for the site, along with the submittal of revised versions of the Health and Safety Plan (HASP) and O&M Plan for the groundwater treatment system. Updated HASP and O&M Plans were submitted, and LSI established environmental covenants with applicable property owners. The ROD, along with the corresponding Administrative Order, requires the preparation and submittal of Biennial O&M Assessment Reports (Biennial Report).

When the 2015 biennial report (August 2015 Biennial) was submitted describing the performance of the GWTS, Wood concluded that baseline conditions had been influenced because of the 2006 redevelopment and it would be prudent to explore other possibilities that update the groundwater management at the Site. As a result, Wood submitted a work plan (2016 Work Plan) to EPA proposing a “Shut-down Test” where the GWTS would temporarily be deactivated as a mechanism to evaluate the plume under natural conditions and update the approach to managing the plume. On December 29, 2015, the 2016 Work Plan to implement temporary system shut down, trend analysis, and pilot test was approved in an email provided by the EPA to LSI Corporation.

The GWTS was shut down temporarily on January 13, 2016 as part of the 2016 Work Plan implementation and resumed operation on December 13, 2016. Re-activation contingencies were identified for select wells and a surface water point near the northern edge of the plume boundary as summarized in the 2016 Work Plan. Wood recommended that the ROD groundwater monitoring be supplemented with additional monitoring events performed in August and February (essentially quarterly monitoring) as outlined in the 2016 Work Plan and under the re-activation contingency values. To date, the contingency targets have not been exceeded so no additional actions have been required as described by the 2016 Work Plan.

On November 22, 2017, EPA provided a letter of approval for the “Interim Next Steps” included in the August 2017 Biennial Operations and Maintenance Assessment Report (2017 Biennial Report). The “Interim Next Steps” outlined the approach/schedule for groundwater monitoring (quarterly) and GWTS operation for this current Biennial Reporting period. Based on the conclusions included in the 2017 Biennial report, Wood reported that the movement of COCs/COIs toward the northern and western property boundary is influenced by preferential pathways via sanitary sewer line utility corridors, and the GWTS operations were optimized to include two (EW9 & EW18) extraction wells instead of 18. These extraction wells were selected because they remove mass most efficiently from the aquifer system and they are closest to the preferential pathways near the center of the Site.

This 2019 Biennial Report, which is the twelfth such report since groundwater remediation commenced in 1995, summarizes the performance of the GWTS when operating during the previous two years, and provides information regarding hydraulic control of the contaminant plume and the contaminant removal efficiency of the GWTS with respect to cleanup goals in the ROD. It also includes a summary of work performed as described in the Interim Next Steps of the 2017 Biennial.

The Administrative Order references the Corrective Measures Implementation (CMI) Report, which provides an outline of specific components of the Biennial Report. Due to the Shut-down Test and work performed during the August 2017 Biennial reporting period, LSI provided a slightly revised outline in the form of a proposed table of contents to EPA in 2017. Based on discussions in a teleconference with EPA on May 31, 2017, EPA accepted the revised outline for the August 2017 Biennial. Wood continued the use of the EPA accepted revised outline for this 2019 Biennial Report since the activities performed during this reporting period reflect and build upon the work described in the August 2017 Biennial.

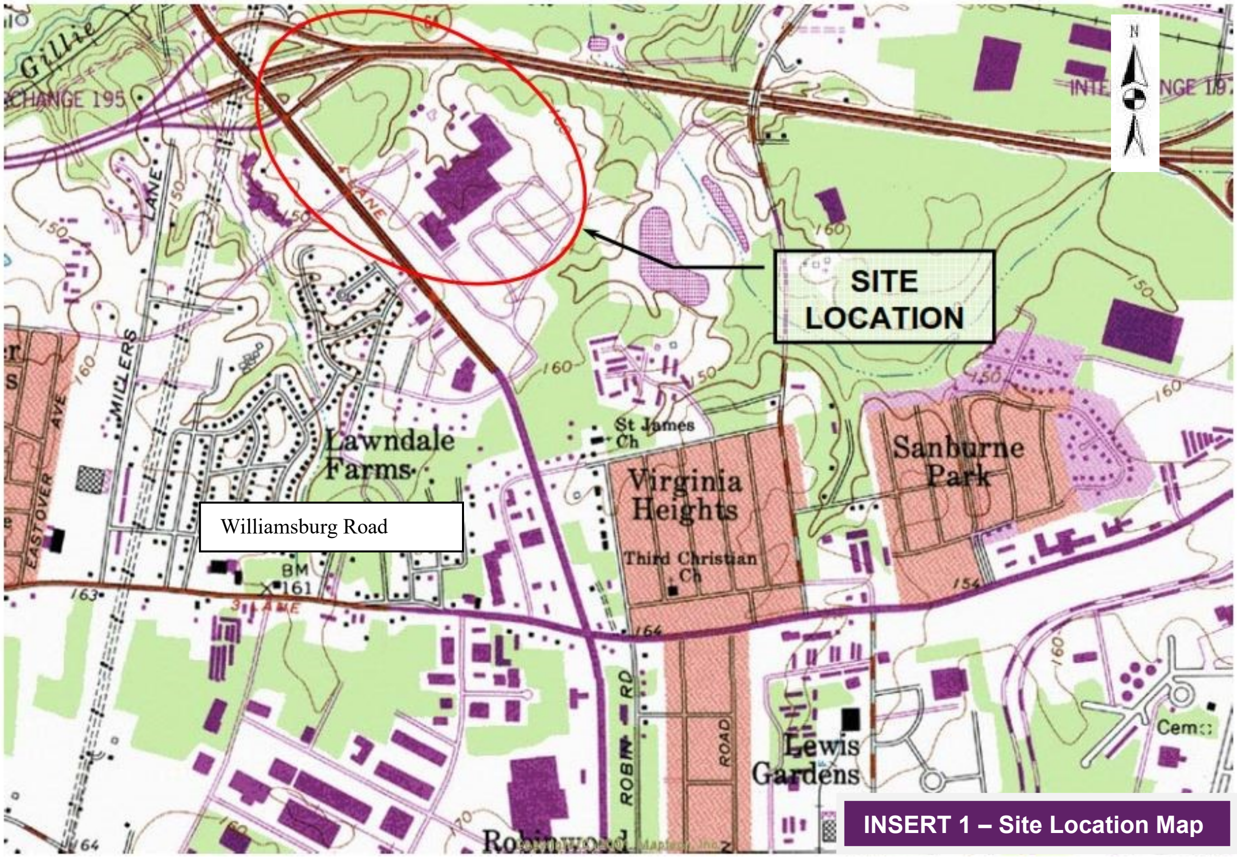
Section 2.0 of this Biennial Report provides a description of the GWTS and corrective measures. Section 3.0 includes a summary of the soil assessment that was performed during the reporting period. The environmental monitoring program, additional monitoring performed during the reporting period, and a summary of groundwater monitoring results are presented in Section 4.0, along with an assessment of remedial progress toward meeting cleanup goals, including graphical depictions of the individual compounds and overall contaminant plumes over time. Sections 5.0 and 6.0 provide an overview of the specific O&M of the groundwater treatment system for the reporting period. Discussion/Conclusions (Section 7.0) and Recommendations (Section 8.0) conclude this Biennial Report.

Appendix A includes relevant historical information and Appendix B includes boring logs for the soil assessment activities. Analytical summary tables for each historical sampling event are presented in Appendix C. Complete historic analytical data summary tables and graphs, for each individual groundwater and surface water sampling point, are provided in Appendix D, including volatile organic compound (VOC) trend graphs for relevant points. Appendices E and F provide groundwater potentiometric maps since the redevelopment, and Mann Kendall graphs that assist with trend analysis, respectively. Lastly, Appendices G and H show Laboratory Data and total VOC and individual compound isoconcentration maps, respectively.

2.0 DESCRIPTION OF CORRECTIVE MEASURES

2.1 Description of Groundwater Extraction and Treatment System

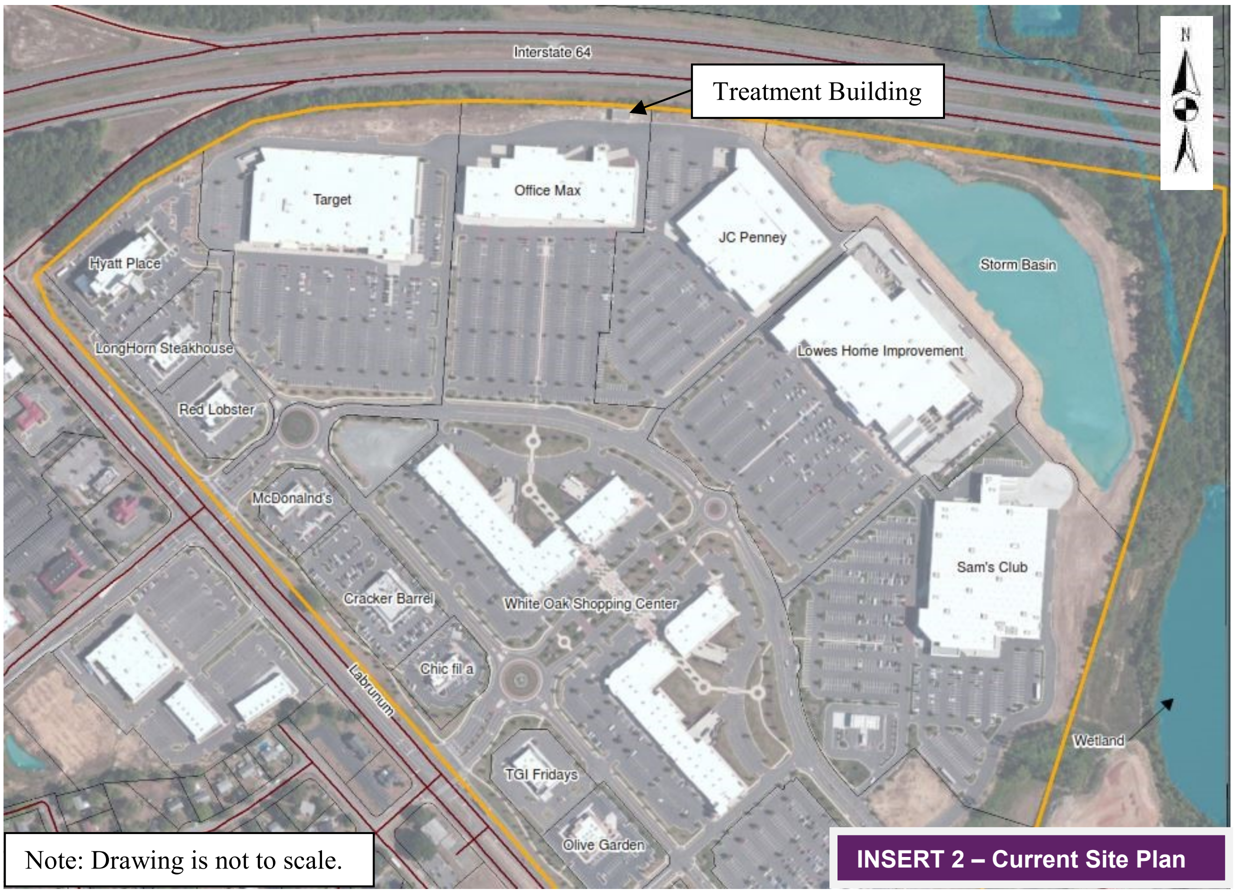
The Richmond Works facility is located in Richmond, Virginia at 4500 South Laburnum Avenue (**Insert 1**; and **Appendix A**: Attachment 1: Site Topographic Map).



Note: Drawing is not to scale.

The Historical Site Plan (**Appendix A**: Figure 2-2) shows the former manufacturing facility, prior to the redevelopment work that occurred in September 2006, and the buildings where the treatment system components were formerly housed. To accommodate the redevelopment plans, the existing structures at the facility were demolished between January and September 2007, including the buildings that housed the GWTS equipment. In addition, during 2007, approximately 6,500 cubic yards of soil containing VOCs were excavated from the reported source area and disposed of off-site at a permitted landfill. Following excavation, the exposed area was covered with a 6-inch to 10-inch layer of red-dyed concrete (**Appendix A**: Figure 2-3). The development plans also required fill material to be placed over the area of the groundwater plume to an average of six feet above previous grade creating additional soil cover between the groundwater plume and the foundation of the new buildings. This demolition and earthwork necessitated rerouting of the infrastructure for all 18 extraction wells, including conduit/wiring for electrical and controls to each well, along with the discharge piping from each well to the new treatment building location. Five of the existing monitoring wells were relocated and one monitoring well was eliminated to avoid building foundations and the storm basin. In addition, the top elevation of most of the extraction and monitoring wells was modified to accommodate the development grading plan. The extraction wells remained in the same location with the well casing, screens, and pumping equipment unchanged from the historic configuration.

Prior to relocation, the treatment system was housed within two buildings adjacent to the main facility. Both structures were demolished, and the existing treatment building is located at the northern perimeter of the site, behind Office Max and adjacent to Interstate 64. **Insert 2** below shows the site in its current configuration, including the existing treatment building.



INSERT 2 – Current Site Plan

The corrective measure remediation system prescribed by the ROD and installed at the facility, consists of a GWTS that includes air stripping and vapor-phase carbon adsorption. The treatment system consists of the following components (**Appendix A**: Figure 2-4 Remediation System Process Diagram):

- 2,000-gallon influent collection tank
- One-horsepower (HP) transfer pump
- Low-profile air stripper designed to provide 99.9% removal of site-related VOCs
- Air stripper includes 7.5 HP blower and 0.5 HP discharge pump
- Vapor-phase carbon canister to treat air stripper off-gas
- Liquid-ring pump (LRP) for DPE of source area wells
- Vapor-phase carbon canister to treat off-gas from LRP, and
- Controls and monitoring devices.

Groundwater containing COCs/COIs is pumped from the 18 extraction wells into the influent collection tank located in the GWTS building. Removal of VOCs from the contaminated groundwater is performed by the air stripper, which has historically transferred the majority of VOCs from the groundwater to the vapor phase. 1,4-Dioxane is also captured by the extraction system but is not treated by the air stripper. See Sections 5.0 and 6.0 for additional details. The groundwater is pumped from the collection tank to the top of the air stripper, where it flows by gravity into a sump located under the tower. The treated groundwater is pumped from the air stripper sump to a Henrico County sanitary sewer manhole, and discharge is regulated by Henrico County Industrial Discharge Permit No. HR1030. The VOC-laden off-gas from the air stripper is forced through an activated carbon canister, which adsorbs the VOCs as they pass through the carbon bed.

Vacuum-enhanced recovery (VER) can be performed on four source area extraction wells (EW9 through EW11, and EW18). Using a high-vacuum LRP in conjunction with a submersible well pump, VER enhances liquid-only pumping in the following ways:

- Increases net effective drawdown and thus increases groundwater extraction rate
- Increases capture zone/radius of influence of well
- Facilitates volatilization within previously saturated soils, and
- Enhances aerobic biodegradation by increasing oxygen flow through the subsurface.

The exhaust from the LRP is treated through a second activated carbon canister prior to discharge to the atmosphere.

The system is automatically operated using a programmable logic controller (PLC). Monitoring devices throughout the treatment system provide feedback to the PLC, which provides control signals to pumps, blowers, and other devices. Abnormal or faulty conditions will trigger an alarm, shutting down the entire extraction and treatment system. Wood is on call 24 hours per day to respond to system alarm conditions.

Level transducers in each of the extraction wells control well pump operation based on predetermined operating levels designed to maximize pumping volume and maintain a cone of depression in the water table surrounding each well. Level switches in the collection tank control air stripper feed pump operation; turning the pump on at a high tank level and turning it off when the tank has pumped down. The blower is controlled in the same way as the feed pump, providing airflow through the stripper and the carbon units whenever water is flowing through the stripper.

The following operational information is displayed and recorded on a weekly basis and is maintained at the facility:

- Influent flow rate from extraction wells [gallons per minute (gpm)]
- Individual totalized flows from extraction wells (gallons)
- pH of influent groundwater; the pH probe in the influent port is cleaned and calibrated monthly
- Effluent flow rate from air stripper sump (gpm)

- pH of treated effluent; the pH probe in the effluent port is clean and calibrated monthly
- Blower pressure
- Vacuum pressure of liquid-ring pump (inches of water), and
- Various pressure gauges throughout the system [pounds per square inch (psi)].

An assessment of overall treatment system performance, as well as a discussion of individual component performance, is presented in Section 6.0. However, the GWTS was deactivated in January 2016 to perform the Shut-down Test. On December 13, 2016, the GWTS resumed operation with groundwater extraction from EW9 to evaluate its effect on the source area. Additionally, EW18 was re-activated on October 3, 2017 to evaluate its effect on restricting the movement of source area concentrations to the western boundary of the site (e.g., MW25 and MW36) via preferential pathways. Except when being repaired, EW9 and EW18 continue to operate and the other extraction wells remain inactive.

2.2 System Upgrades/Field Assessment for the Enhancement of Corrective Measures

Typical operation of the GWTS occurred from June 2017 to May 2019, and during this time while general maintenance was performed, no system upgrades were required or performed.

When EW9 and EW18 were activated in December 2016 and October 2017, respectively, following the Shut-down Test, typical maintenance was performed on EW9 and EW18 to keep both operational. No system upgrades were required or performed.

Since the reactivation of the GWTS in December 2016 and as described in the Interim Next Steps of the August 2017 Biennial, quarterly groundwater monitoring was implemented as the ROD sampling was performed on the typical schedule in November/December and in May, and a subset of monitoring wells, typically about 30, were sampled in February and August. For a summary of the monitoring wells that were sampled during this reporting period, see **Table 1**. **Figure 1** shows the location of extraction and monitoring wells located on the site. Additionally, a summary of groundwater and surface water analytical results since the implementation of the Shut-down Test (e.g., November 2015) are provided in **Table 2**.

2.3 Third Explanation of Significant Differences

During the redevelopment of the site into a retail shopping center, the property was subdivided and some of the parcels were subsequently sold to individual retail/development entities. A draft Third Explanation of Significant Differences (ESD) was published by EPA in July 2009 for public comment, implementing IC requirements for the site to address potential issues with property ownership and site development. The final ESD was issued by EPA on May 24, 2011.

2.4 Revised Administrative Order on Consent

On March 4, 2013, the EPA issued a final Administrative Order on Consent to replace the 1996 unilateral order with Lucent. LSI and Alcatel are both listed as respondents on the new order. The new order required LSI to implement ICs for the site, along with the submittal of revised versions of the HASP and O&M Plan for the GWTS. Six environmental covenants have been agreed upon and recorded, which cover parcels owned by BRE DDR BR White Oak VA LLC (Office Max and the rest of the White Oak Village), GMRI Inc. (Olive Garden), Rare Hospitality International, Inc. (Longhorn), Lowe's Home Centers LLC (Lowe's Home Improvement), Oak LLC (Hyatt), and Target. The requirement to obtain environmental covenants for Red Lobster and Steak & Shake, after best efforts by LSI, was vacated by USEPA per emails dated 27 February 2018 and 25 July 2018. Environmental covenants were not needed for Sam's Club and Panera Brad parcels of the facility per USEPA letter dated 23 February 2016.

3.0 SOIL ASSESSMENTS

During this reporting period, further assessment was performed to identify areas of vadose zone soil impacts remaining in the subsurface that may be contributing to the mass transfer of contaminants to groundwater.

In October 2018, Wood mobilized to the site to collect soil samples in the vicinity of the former tank farm and underground concrete pads to further assess impacted vadose zone soil identified in the 2017 soil assessment (2017 Biennial Report). Each concrete pad (**Figure 2**) was located approximately 3.5 feet below ground surface. The soil samples were collected from borings advanced with a Geoprobe® using direct push methods. A total of 37 soil borings were advanced to depths between 15 and 20 feet below ground surface and soil samples from the borings were field-screened using a ppb RAE photoionization detector (PID) on 1-foot intervals. Of these 37 borings, three of the borings encountered refusal and so, soil samples were not collected. Generally, the soil sample with the highest PID measurement in the vadose zone for each boring was collected in laboratory-provided sample containers and sent to Air, Water, and Soil Laboratories, Inc. for analysis of VOCs according to SW Method 8260B. Other select soil samples (three) were submitted to the laboratory to assist with vertical delineation. A total of 37 soil samples were submitted for laboratory analysis. A compilation of the 2017 and 2018 analytical data for site contaminants of concern/interest (COCs/COIs) are summarized in **Table 3** and boring logs were completed to record PID readings and soil classifications (**Appendix B**). **Figure 2** identifies the locations of soil borings from the 2017 and 2018 assessments.

Additionally, two groundwater samples were collected during this soil assessment at locations below each underground concrete pad (i.e., GP-2018-46 and GP-2018-50) to obtain an understanding of potential groundwater impacts. PVC pipe was installed within the two boring locations as a temporary well and groundwater samples were collected into laboratory-provided containers using a waterra check valve and tubing and sent to Air Water, and Soil Laboratories, Inc. for analysis of VOCs according to SW Method 8260B. Groundwater results from these two locations may be different if collected from a permanent monitoring well, therefore, the groundwater results are used for comparative purposes only.

A soil assessment was also performed in 2017 and reported in the previous Biennial Report. The 2018 assessment refined work performed in the 2017 assessment, so for overall clarity, the following paragraphs summarize observations of the 2017 and 2018 soil assessments:

- <u>Constituents such as TCA, MEC, and 1,4-dioxane are present at substantially elevated concentrations in the vadose zone near the locations of factory buildings (Buildings 51 & 33) and the Tank Farm</u> (**Figure 3**). Because these constituents are not degradation products, but instead were present in chemicals used in the manufacturing process and are found close to historical manufacturing activities, these high concentrations indicate historical releases and a primary source of impacts to groundwater rather than a result of matrix effects.

- The impacts, particularly beneath the concrete pads, extend from depths of approximately 7 feet below land surface to the depth of the groundwater-soil interface or smear zone.

- Groundwater impacts beneath the concrete pads are the highest total VOC concentrations measured at the Site to date.

- <u>Clay is the predominant soil type from the land surface to the depth of groundwater at approximately 15 to 20 feet below land surface</u>. Particularly in areas of historically high COC concentrations in groundwater, it is possible that VOCs have been introduced to previously unimpacted areas of clay along the groundwater interface, creating "matrix effects" where the clay provides a recurring source of residual VOCs to groundwater over larger areas of the site. This matrix effect may be contributing to the stable mass of VOCs remaining in the groundwater year after year and is a separate condition from vadose zone soil that has been impacted as a direct result of a release.

To target vadose soil with the greatest VOC mass and representative of a historical release, areas were identified that meet the following criteria: 1) concentrations of TCA, MEC and 1,4-dioxane, (constituents of manufacturing chemicals used in the manufacturing process), that are 100 times the EPA Protection of Groundwater Site Screening Levels or greater, 2) located beneath former structures, 3) located beneath concrete pads, and/or 4) believed to be void of utilities (**Figure 3**). Target concentrations at 100 times the SSL are 28,000 µg/kg for TCA, 270 µg/kg for MEC and 9.4 µg/kg for 1,4-dioxane. According to the EPA's *Soil Screening Guidance: Technical Background Document* (EPA, 1996), EPA Protection of Groundwater Site Screening Levels are estimated based on a dilution factor of the Maximum Contaminant Levels that estimates the concentration of soil leachate that could conservatively impact groundwater. Wood is not targeting all areas of soil that could possibly impact groundwater. For example, Wood is not targeting areas of lower-concentration soil that may re-contaminate groundwater due to matrix effects, but only areas of high vadose zone soil concentrations likely resulting directly from historical releases.

4.0 ENVIRONMENTAL MONITORING

4.1 Overview of Environmental Monitoring Program

4.1.1 Summary of Objectives

As provided in the ROD dated June 28, 1991, and in the First ESD dated February 13, 1992, the site-specific cleanup goals for groundwater and surface water are shown in **Table 4**.

Periodic groundwater monitoring has been conducted since the installation of the first monitoring wells in the fall of 1987, and periodic surface water monitoring has been conducted since May 1987.

Environmental monitoring at the Richmond Works facility was conducted in accordance with the Revised Sampling and Analysis QA/QC Program (SAP), Second Revision, June 30, 2000. In accordance with the revised SAP, sampling of a more complete data set has been performed on a semi-annual basis since May 2000. The annual monitoring event was typically performed in April/May of each year and the semi-annual event was typically performed in October/November. However, annual events were performed in November 2017/2018 and semi-annual events were performed in May 2018/2019 during this reporting period. Wood performed trend analysis on monitoring results using the GSI Mann-Kendall Toolkit. Generally, when trends are discussed, the trend analysis is performed from the beginning of Work Plan implementation in January 2016 to the last date the well was sampled except where otherwise noted.

Specifically, groundwater sampling was performed twice a year as required by the ROD in May and November. In addition to the ROD requirements, groundwater sampling was also performed in February and August based on the Interim Next Steps of the August 2017 Biennial Report. Refer to **Table 1** for groundwater and surface water monitoring locations and sampling frequency during this reporting period.

The overall objectives of environmental monitoring within this reporting period inclusive of the ROD requirements are presented below.

- Acquire a yearly snapshot of all monitoring points associated with the site except for specific monitoring points that historically do not contain VOCs.
- Characterize the plume with another sampling event six months from the annual event.
- Document changes in groundwater VOC concentrations at designated compliance points and other groundwater sampling locations under reduced pumping conditions.
- Document changes in surface water VOC concentrations in Gillie Creek, at designated compliance points and at other surface water locations.
- Characterize the movement of groundwater under reduced pumping conditions.

- Evaluate the contribution of abiotic/biotic processes in the removal of COCs and COIs under reduced pumping conditions.
- Optimize groundwater treatment system operations.

During this reporting period, data analysis was focused on, but not limited to, the following:

- Points of Compliance (MW10, MW17, MW28, SW15, SW21, and SW67) used to monitor cleanup goals as designated by the ROD;
- Contingency points (MW50, MW51, MW53, MW54, MW55, MW56, and SW67) used largely for monitoring the northern boundary of the plume designated by the 2016 Work Plan; and
- Monitoring wells of interest (MW25, MW33, MW34, MW35, and MW36) identified in the 2016 Work Plan and 2017 Biennial Report.

4.1.2 Overview of Surface Water Monitoring

Gillie Creek and associated tributaries are located north and downgradient of the facility, and a wetland area lies between the creek and Interstate 64. Because of Gillie Creek, tributaries and the wetland may receive discharge from the Site, therefore, surface water sampling is required at SW15, SW20, SW21, and SW67. SW15, SW21, and SW67 are points of compliance (POCs). Specifically, groundwater to the northeast of the facility can flow into Gillie Creek in the area of monitoring point SW21 and as such it was designated a POC. Refer to **Figure 1** for surface water point locations.

Further downstream (toward the west), the water-bearing zone has been eroded and subsequently reworked into the floodplain of Gillie Creek; the groundwater in this area reportedly enters the creek indirectly through the shallow surface soils of the wetland floodplain. In addition, off-site monitoring wells installed in 1999 show that a north-south sanitary sewer line under Interstate 64 serves as a preferential pathway, allowing for a more rapid migration of groundwater from the site toward Gillie Creek. SW67 is located along this preferential pathway within a tributary that flows into Gillie Creek (**Figure 1**) and therefore is considered a POC. SW15 is located north of SW67, and SW20 is 4,000 feet downstream from SW15 to the west of Laburnum Avenue. SW20 is used as a control point to provide continued assurance that VOCs have not migrated downstream. Note that SW20 is not displayed in **Figure 1** based on the scale displayed.

4.1.3 Overview of Groundwater Monitoring

During this reporting period, groundwater sampling was performed in November and May as referenced in the ROD. In addition to the ROD requirements, groundwater sampling was also performed in February and August (**Table 1**).

Grab samples were collected at each location and analyzed in the laboratory for VOCs via SW846 Method 8260B. Wood also sampled specific wells for 1,4-dioxane (SIM) via SW846 Method 8260B to obtain a detection limit (<2.0 μg/L) suitable for comparison of the EPA Risk Level (6.1 μg/L).

Analytical summary tables for each historical sampling event since 2006 are presented in **Appendix C**. Historical data summaries for each individual monitoring point are presented in **Appendix D**. VOCs and specific contaminant tables and trend graphs for compliance points are included in the tables and figures, as referenced in the following sections.

In the laboratory results tables, the term "total VOCs" refers to the sum of VOCs detected using SW846 Method 8260B. Throughout the sampling record, the four subject compounds (DCA, DCE, MEC, and TCA) have been detected above the laboratory reporting limit with occasional detections of other VOCs. In addition, other constituents associated with petroleum and polymer/foam have been detected at the site. As an example, benzene was detected in groundwater samples collected from MW2, MW6, MW7, MW10, MW16, MW17, MW18, EW10, EW14, and EW18 at least once during the reporting period. For clarity, "other VOCs" are reported as Total VOCs minus the sum of TCA, DCA, MEC, DCE, VC and detectable concentrations of 1,4-dioxane or 1,4-dioxane (SIM). **Table 5** lists the compounds that have been historically detected at the site. Compounds reported with J qualifiers (quantitation of analyte between the reporting limit and the method detection limit) were reported during this reporting period. However, variations of the compounds (e.g., 1,2-DCA and 1,1,2-TCA) have not been included.

Laboratory analysis and reporting procedures changed beginning with the April 2002 sampling event. In accordance with standard protocol, the laboratory analyzes an undiluted sample for each monitoring point; if any of the compounds are detected above the calibration curve, the lab analyzes and reports a diluted sample for only those compounds. Currently, the standard "non-detection" value is less than the limit of detection (LOD). The reporting of J qualified compounds is based on values at less than the limit of quantitation (LOQ) and include detections between the LOD and LOQ.

For this reporting period, groundwater elevations were obtained on a quarterly basis to develop site-wide groundwater potentiometric maps for each sampling event. The potentiometric maps are used to observe changes in the plume (e.g., groundwater flow patterns) under non-pumping/limited pumping conditions. In general, the groundwater potentiometric maps indicate a consistent groundwater flow pattern toward the northwest across the site (**Appendix E**). The redevelopment appears to have affected local groundwater elevations in certain areas of the site which is discussed in greater detail in Section 4.5

Five production wells were **formerly** associated with the Site (PW1 through PW4 and Gillies Well). Each of these wells were installed in a deeper aquifer, while the monitoring and extraction wells associated with the contaminated groundwater from the facility are installed in a surficial water-bearing zone, where the VOCs are confined. VOCs were not detected in the deeper aquifer at the site and theses wells no longer exist and as such were not sampled in this reporting period.

4.2 Surface Water Compliance Point Monitoring Results and Trends

Surface water sampling is required at SW15, SW20, SW21, and SW67. SW15, SW21, and SW67 are POCs. <u>COCs have not been detected above the cleanup goals in surface water samples since 1999. COIs have not been detected above cleanup goals in surface water samples.</u> The highest VOC concentrations in Gillie Creek were historically measured at SW21. Although 16 of 18 extraction wells were deactivated during this reporting period, concentrations of the four COCs at SW21 have been below cleanup goals since February 1999 and below detections of 1 µg/L since February 2000, with the exception being DCE at 2.7 µg/L in October 2003. DCE has been less than the detection limit of 1 µg/L in the 29 sampling events since that date. Monitoring at SW21 continues to indicate that VOCs are not likely present within Gillie Creek at concentrations exceeding the cleanup goals and have not been since February 1999.

Concentrations in SW15, which is approximately 2,000 feet downstream from SW21, had averaged approximately 10% of SW21 values throughout the early 1990s. Despite reduced pumping conditions, SW15 has been below cleanup goals since May 1996. SW20, another surface water location approximately 4,000 feet downstream from SW15, is a control point where VOCs have not been reported above detection limits and/or detections of 1 µg/L since May 1995, with the exception of 11 µg/L of TCA in November 2000. These results suggest that COCs have not migrated downstream. Since SW67 (modified) was established, VOCs have been below cleanup goals during the 26 sampling events and below detections of 1 µg/L since October 2006 when considering sampling that occurred as required by the ROD.

Monitoring indicates that surface water results have not exceeded the cleanup goals since November 1995 (SW15). TCA has not exceeded cleanup goals in surface water monitoring points, and MEC and VC have not been detected in surface water samples.

Methyl tertiary butyl ether (MTBE) has been sporadically detected in SW21 (0.2J to 2.9 µg/L) and SW15 (0.2J to 2.7 µg/L) between 2003 and 2010, and in SW20 (0.3J to 0.4J) between 2005 and 2010. This compound is a common fuel additive in gasoline, which is not associated with historical activities at the former Richmond Works site and was not detected during this reporting period.

4.2.1 Surface Water Station SW21

Near SW21, Gillie Creek is a gaining stream. Historical laboratory analytical data for SW21 are presented in **Table 6** and represented graphically in **Figure 4** since 2004 and immediately prior to redevelopment.

Considering monitoring results since 2004, VOC concentrations show an overall VOC decline and VOCs concentrations appear largely unchanged since 2012. Concentrations in SW21 have not exceeded cleanup goals since November 1999.

4.2.2 Surface Water Station SW15

Near SW15, groundwater flows through a wetland prior to discharging into the creek. SW15 is located downstream of a potential preferential pathway (i.e., sanitary sewer line) from the site and immediately downgradient of EW14, EW15, EW16, and EW17. These extraction wells were brought on-line prior to the November 2000 sampling event. Historical laboratory analytical data for SW15 are presented in **Table 7** and represented graphically in **Figure 5**.

As illustrated in **Figure 5**, there has been an overall VOC decline at SW15, with DCE being the single constituent ever noted above the cleanup goal. DCE has not been reported above the 1 µg/L limit of quantitation since April 2002 (33 sampling events). TCA has been below the detection limit and/or below 1 µg/L since May 1997, the only exception being 11 µg/L in November 2000. Neither DCA nor MEC has been detected at SW15 with the exception of 0.1 µg/L of DCA detected in April 2002. SW15 has been in compliance with the cleanup goals as stated in the ROD since May 1996.

4.2.3 Surface Water Station SW67 (Modified)

As stated above, the original SW67 was noted in the original order (1994) to be inaccessible and was therefore eliminated as a compliance point. A modified sampling point was established in the vicinity of the original SW67 and added to the revised SAP sampling program beginning in May 2000. SW67 is located within a tributary that flows into Gillie Creek. This tributary receives surface water runoff from the site and is considered an off-site preferential groundwater flow pathway, as it is adjacent to the sanitary sewer line and immediately downgradient of EW14, EW15, EW16, and EW17. Historical laboratory analytical data for SW67 are presented in **Table 8** and represented graphically in **Figure 6**.

No analytical data is available for the original SW67. All compounds have been below cleanup goals in the 26 samples that have been obtained since May 2000 from the modified SW67 during ROD sampling and in the twelve additional samples collected from SW67 because SW67 was also part of the post Shut-down contingency sampling. A summary of the post Shut-down Test results is provided in **Table 2**. TCA was twice reported above the quantitation limit of 1 µg/L (8.1 µg/L, November 2002 and 12 µg/L, October 2005) and 1,4-dioxane was once reported above the LOD at 2.04 µg/L in March 2016.

4.2.4 Overall Surface Water Trend Assessment

The overall surface water trend is represented by stations SW15 and SW21; contaminants have not been regularly detected in SW20 (downstream control point). An overall downward trend at stations SW15 and SW21 to April 2012 indicates that the source of VOCs discharging into Gillie Creek is being depleted. After April 2012, VOC concentrations appear stable inclusive of this reporting period. **Figure 7** shows the combined total VOCs in three primary surface water monitoring points (SW15, SW21, and SW67). <u>The data indicate that the cleanup goals for surface water stated in the ROD have been attained and maintained since at least 1999.</u>

4.3 Groundwater Compliance Point Monitoring Results and Trends

Sampling of the three on-site monitoring wells designated as compliance points (MW10, MW17, and MW28) was performed on a quarterly basis until May 2000, when sampling changed to semi-annual in accordance with the revised SAP. Since February 2017, these wells have been sampled quarterly due to reduced pumping of the GWTS during this reporting period. These results are summarized in **Tables 2, 9, 10, and 11**. A discussion of reporting period results is included below.

4.3.1 Monitoring Well MW10

Monitoring well MW10 historically has exhibited the highest VOC concentrations of site-related monitoring wells. Historical laboratory analytical data for MW10 are presented in **Table 9** and represented graphically in **Figure 8**.

Between 2005 and 2007, the average total VOC concentration was less than 1,900 µg/L, nearly three orders of magnitude below the historical maximum concentrations prior to the redevelopment.

During the site redevelopment beginning in July 2007, the tank farms, buildings, and paved areas adjacent to MW10 were demolished, and the soil in the reported source area was exposed to rainwater percolation. Approximately 6,500 cubic yards of soil containing low levels of VOCs were excavated from the reported source area and disposed of off-site at a permitted landfill. Following excavation, the exposed area was later covered with a 6-inch to 10-inch layer of red-dyed concrete presumably to help prevent infiltration from the surface as discussed in the soil assessment (Section 3.0). The development plans also required fill material to be placed over the area of the groundwater plume to an average of six feet above previous grade creating additional soil cover between the groundwater plume and the new buildings. However, this redevelopment work caused a 40-fold increase in VOC concentrations in MW10 during the October 2007 sampling event, to levels that had not been observed since 1995. The following three sampling events (May and November 2008, and May 2009) showed a decrease to approximately 10% to 30% of the October 2007 concentrations.

In addition, 25 of the 30 groundwater samples collected since May 2009 inclusive of this reporting period showed Total VOC concentrations less than 5,500 µg/L (**Tables 2 and 9**) including those during this reporting period. **Figure 8** shows an overall decline in Total VOCs since May 2009.

Wood conducted a statistical trend analysis using the GSI Mann-Kendall Toolkit (GSI, 2012) to evaluate concentrations of COCs, COIs, and total VOCs detected in groundwater samples collected from MW10 since January 2016 (**Table 2**) (**Appendix F**). Specifically, DCA, 1,4-dioxane, MEC, and Total VOCS showed concentration trends that are "stable/no trend" and TCA showed concentration trends which are "probably decreasing" since January 2016. As explained in GSI Mann-Kendall Toolkit, a classification of "no trend" is similar to a "stable" result and provides statistical evidence that concentrations have remained stable during this reporting period. The DCE concentration trend appears to be "increasing" but is likely due to the location near the vicinity of EW9 and EW18, both of which have been active since December 2016 and October 2017, respectively. Interestingly, the VC concentration trend is "increasing" suggesting the possible removal of TCA via anaerobic abiotic/biotic mechanisms.

Although MW7 is not considered a compliance point, it is a location where some of the highest concentrations of TCA have been reported over time (**Appendix D**) and in this reporting period (typically >4,000 µg/L). Trend analysis developed from the GSI Mann-Kendall Toolkit based on results from MW7 show "stable/no trend" for DCE, 1,4-dioxane, MEC, and VC, and "decreasing" or "probably decreasing" trends for TCA and Total VOCs. Although Total VOCs show "probably decreasing trends", the DCA concentration trend for MW7 is "increasing" particularly since the last sampling event in May 2019 when concentrations were greater than 2700 µg/L compared to 776 µg/L in February 2019.

4.3.2 Monitoring Well MW17

Well MW17 is sited on the northern perimeter of the facility approximately 750 feet downgradient of MW10 and between EW14 and EW15. Historical laboratory analytical data for MW17 are presented in **Table 10** and represented graphically in **Figure 9**. A focus on Shut-down Test and quarterly results is presented in **Table 2**. Historically, there has been an overall decline in VOCs at MW17. **Figure 9** illustrates the decline since 2004 prior to redevelopment.

Wood conducted a statistical trend analysis using the GSI Mann-Kendall Toolkit (GSI, 2012) to evaluate concentrations of COCs, COIs, and Total VOCs detected in groundwater samples collected from MW17 since January 2016. The results of the trend analysis are presented in **Appendix F** and suggest that concentrations of TCA, DCA, DCE, 1,4-dioxane, and Total VOCs are "probably decreasing/decreasing" while concentrations of MEC and VC are "stable". Note that MEC has historically been below detection limits and/or below the 5 µg/L cleanup goal.

4.3.3 Monitoring Well MW28

Well MW28 is located approximately 250 feet east of MW10. According to historical reports, this well appears to be influenced by anisotropic conditions within the aquifer and by adjacent buried pipes that may have served as a preferential pathway for the transport of VOCs from a former vapor recovery building sump. Previous records also indicate that extraction well EW11 was placed adjacent to MW28 to take advantage of relatively high contaminant concentrations and hydraulic conductivity observed in MW28. Historic laboratory analytical data for MW28 are presented in **Table 11** and represented graphically in **Figure 10**.

As illustrated in **Figure 10**, there has been a significant VOC decline at MW28 over the period of record. Most notable is the period since May 1995, prior to which the total VOC concentration averaged greater than 80,000 µg/L. Since 2004, the total VOC concentration has averaged approximately 384 µg/L, an approximate 210-fold reduction in concentration (**Tables 2 and 11**).

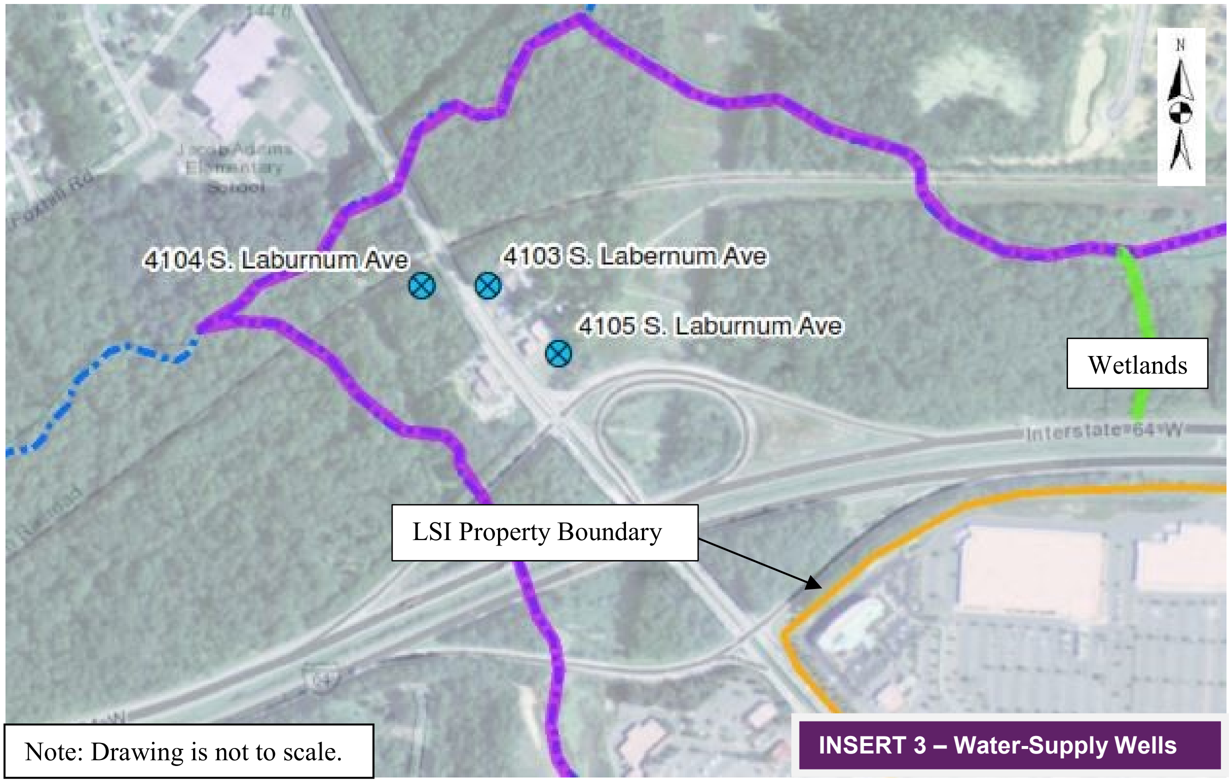
MEC has been reported as below the limit of detection and/or below the level of quantification in MW28 since 1995. Concentrations of TCA and MEC were below each cleanup goal during this reporting period. Since January 2016, the result of Mann-Kendall Trend Analysis indicates that TCA, DCE, 1,4-dioxane, and Total VOC concentrations are "decreasing" and that MEC and VC concentrations are "stable/no trend". Conversely, the DCA concentration trend appears to be "increasing" and be a result of the biological degradation of TCA.

4.3.4 Contingency Wells

Two potential receptors were identified in the 2016 Work Plan Conceptual Site Exposure Model along the northern and northwest property boundary that required supplemental monitoring (e.g., quarterly) along the northern property boundary during reduced pumping conditions of the GWTS and following the submittal of the August 2017 Biennial Report. These potential receptors included three water-supply wells that were identified northwest of Highway 64 and off-site wetlands associated with Gillie Creek located north of Highway 64[2]. In 2014 and early 2015, Wood confirmed the presence of three water-supply wells (4103 S. Laburnum, 4104 S. Laburnum and 4105 S. Laburnum Avenue) located approximately 850 feet northwest of the Highway 64 "cloverleaf" (Cloverleaf) within the tributaries that border the site and feed into Gillie Creek. The three water-supply wells operate at service/gas stations, and reportedly are not used for drinking or cooking water. The information obtained from Mr. Mel Crowder of Crowder's Service Station at 4104 S. Laburnum indicate that his water-supply well is 45 years old and is about 225 feet deep and is screened in a different aquifer than the LSI Plume.

As part of the 2016 Work Plan implementation, MW50, MW51, MW53, MW54, MW55, MW56, and SW67 were sampled quarterly (inclusive of ROD sampling) from June 2016 to the present. Sample results from MW50 and MW51 can trigger a contingency to resample and/or activate the GWTS or other treatment when compared to groundwater contingency values. For detail on the groundwater contingency path, see the 2016 Work Plan. The groundwater contingency values were assigned based on the presence of three water-supply wells located approximately 850 northwest of the Highway 64 "cloverleaf" (Cloverleaf) and illustrated in **Insert 3**.

[2] Additional Work Plan; Preliminary Conceptual Site Exposure Model; Section 5.2; January 2016.



The groundwater contingency values were estimated from back calculated concentrations (2016 Work Plan) that if present in MW50 and MW51 suggest concentrations no greater than the ROD Cleanup Goals at the water-supply wells noted in **Insert 3** above.

Groundwater monitoring results received and validated with EPA Stage 2B validation (**Appendix G**) during this reporting period <u>did not exceed</u> the contingency values. A summary of the groundwater contingency results is included in **Table 12**. The most recent results are summarized in **Insert 4**.

Insert 4: Groundwater Contingency Table			
Constituents	**GW Contingency Value (µg/L)[1,2]**	**Actual MW50 (µg/L)[3] May 15, 2019**	**Actual MW51 (µg/L)[3] May 15, 2019**
1,1,1-TCA	4,000	0.73 J	14.0
1,1-DCA	80	0.75 J	11.0
1,1-DCE	150	10.2	113
MEC	100	<1.00	<1.00
1,4-Dioxane	92	4.91	55.0
VC	40	<0.50	<0.50

Notes:
(1) The GW Contingency Value for 1,1,1-TCA, 1,1-DCA, 1,1-DCE, and MEC was estimated based on the ROD Clean up Level.
(2) The GW Contingency Value for 1, 4-dioxane was estimated based on its RSL at risk of 10^{-5} MCL, and the GW Contingency for VC was estimated based on its MCL.
(3) J = Estimated value below the laboratory reporting limit

Surface water contingency values were also assigned for MW53, MW54, MW55, MW56, and SW67 in the 2016 Work Plan based on the Virginia Department of Environmental Quality Tier II Surface Water Criteria and the potential to impact the wetlands north of Highway 64 (**Insert 5**). Surface water monitoring results received and validated with EPA Stage 2B validation during this reporting period, specifically during the Shut-down Test, did not exceed the contingency values. A summary of the surface water contingency results is included in **Table 13**. The most recent results are summarized in **Insert 5**.

Insert 5: Surface Water Contingency Table							
Constituent	**Tier II SW Criteria (recreational use) µg/L**	**Tier II SW Criteria (biota ingestion) µg/L**	**Actual MW53 May 15, 2019 µg/L**	**Actual MW54 May 15, 2019 µg/L**	**Actual MW55 May 15, 2019 µg/L**	**Actual MW56 May 15, 2019 µg/L**	**Actual SW67 May 15, 2019 µg/L**
1,1-DCE	*10,000*[a,1]	7,100[b]	2.26	<0.70	<0.70	<0.70	<0.70
1.1-DCA	*1,700*[a,2]	*5,848*[c,2]	1.36	<0.60	<0.60	<0.60	<0.60
1.1.1-TCA	*330,000*[a,1]	*896,000*[c,1]	<0.60	<0.60	0.79 J	<0.60	<0.60
Methylene Chloride	*3,000*[a,1]	5,900[b]	<1.00	<1.00	<1.00	<1.00	<1.00
1,4-Dioxane	*550*[a,2]	571[c,2]	<2.00	<2.00	<2.00	<2.00	<2.00
VC	*20*[a,2]	24[b]	4.12	<0.50	<0.50	<0.50	<0.50

Notes: The most stringent of the recreational use or biota ingestion values identified by blue shading is the SW contingency.
(1) Based on HI = 1
(2) Based on 1 x 10^{-5} risk
(a) VDEQ, Surface Water Risk Calculations
(b) Virginia Water Quality Standards – Other Surface Water/VRP Tier II Screening Level
(c) Wood derived using the equations/procedures for EPA and VDEQ. Most stringent criteria
J = Estimated value below the laboratory reporting limit

Please see the 2016 Work Plan for details on how the contingency values were estimated.

In summary, groundwater (**Insert 4**) and surface water (**Insert 5**) contingencies were not exceeded for the trigger water samples, so the contingency was not activated during this reporting period (June 2017 to May 2019).

4.3.5 Other Wells of Interest

Monitoring wells MW25, MW35, and MW36 are located along the western property boundary and may be affected by sanitary sewer utility preferential pathways moving from the center of the site toward the west and along the western property boundary (**Figure 1**). The Mann-Kendall Toolkit indicated "increasing" or "probably increasing" concentration trends of specific COCs for MW25 (TCA, DCA, DCE, and 1,4-dioxane), MW35 (TCA and DCE), and MW36 (TCA), located along the western property boundary since November 2015. However, since at least November 2016 for MW35, the Mann-Kendal Toolkit indicates either a "decreasing" or "stable/no trend" for COCs/COIs. Total VOCs in MW36 have fluctuated between "no trend" and "increasing" since January 2016 and currently has "no trend"; and concentrations in MW25 do not appear to be stable. Several factors could contribute to increasing concentrations in MW25 including its location near an intersection of three sanitary sewer lines that may be leaking and/or channeling impacted groundwater along the utility corridors toward MW25.

Other monitoring wells of interest include MW33 and MW34 that also appear to be located along preferential pathways. In MW33, concentration trends of TCA, DCA, DCE, 1,4-dioxane, and Total VOCs are “decreasing” or “no trend” since February 2016. In addition, the increasing concentrations of VC in MW33 suggest that biotic or abiotic degradation is occurring[3] while the increasing concentrations of MEC in MW33 are likely influenced by contaminant transport from the source area via the preferential pathways along the utility corridors. In MW34, concentrations of COCs/COIs and Total VOCs are “stable” or “decreasing” since March 2016.

4.4 Overall Groundwater Trend Assessment

Between June 2017 and May 2019, the GWTS was operational. However, 16 of 18 extraction wells were inactive during that timeframe. EW9 was activated in December 2016 and EW18 was activated in October 2017.

A comprehensive historical analytical profile and graph for each individual site monitoring point is presented in **Appendix D**. The graphical representation of Total VOCs over time for MW10, MW17, and MW28 is presented in **Figures 8 through 10**. **Appendix H** contains VOC isoconcentration maps over the period of record from 2006 to 2019, including Total VOC, DCA, DCE, MEC, TCE, 1,4-dioxane, and VC constituents. Total VOC isoconcentration maps from November 2017, May 2018, November 2018, and May 2019 are included as **Figures 11 through 14.**

Redevelopment activities that began in 2006 appear to have influenced contaminant concentrations throughout the site. Activities between 2006 and the present that may have affected groundwater flow and rainwater percolation through the vadose zone include:

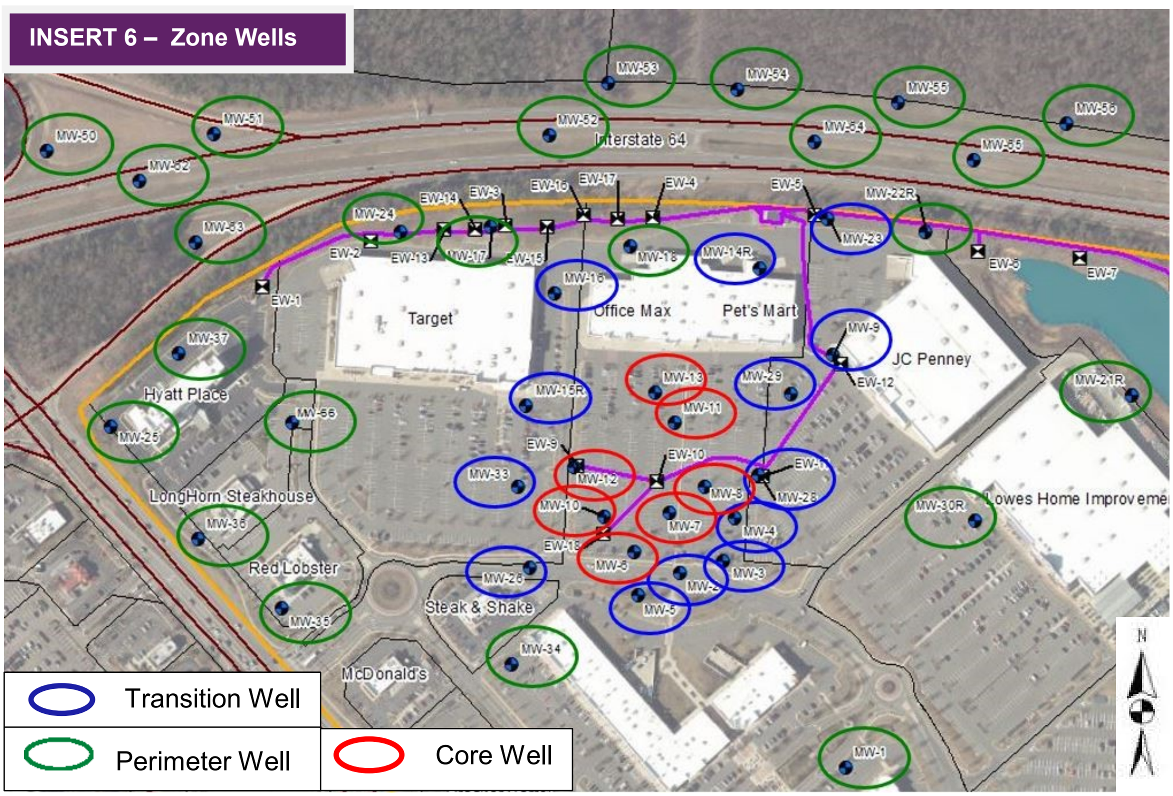
- Construction (September 2006) and subsequent removal (September 2007) of a sediment basin on the perimeter of the site, between monitoring wells MW16, MW17, and MW18,
- Construction (mid-2007) of a storm basin on the east side of the site perimeter, adjacent to extraction wells EW6, EW7, and EW8 and monitoring well MW21R,
- Demolition of buildings located on the site (September 2006 through September 2007), as well as removal of all paved areas throughout the site, fully exposing the surface soil on a formerly predominately impermeable site,
- Redevelopment including increasing the land surface elevations in the source area by an average of six to seven feet may have affected rainwater percolation,
- Removing approximately 6,500 cubic yards of soil containing low levels of VOCs from the source area and disposing of the soil offsite and adding a concrete barrier to help prevent subsurface infiltration,

[3] Final Protocol for In Situ Bioremediation of Chlorinated Solvents Using Edible Oil, Air Force Center for Engineering and the Environmental Science Division Technology Transfer Outreach Office, October 2007.

- Installation of large subsurface utility lines to support the development of the site, and
- Construction of new buildings and parking lots throughout the site between October 2007 and early 2009.

The information below includes a summary of surface water results, compliance monitoring results, contingency monitoring results, and results from other monitoring wells of interest to indicate an overall trend in contaminant plume data.

To facilitate discussion of overall contaminant trends, monitoring wells were divided into the core zone represented by (MW6, MW7, MW8, MW10, MW11, MW12, and MW13), the transition zone (MW2, MW3, MW4, MW5, MW9, MW14R, MW15R, MW16, MW23, MW26, MW28, MW29, and MW33), and the perimeter zone (remaining wells) based on historical concentrations and contouring. See the wells as designated in **Insert 6**.



Note: Drawing is not to scale.

4.4.1 Core and Transition Zone

In general, changes in rainwater infiltration associated with construction activities impacted contaminant concentrations at the site particularly near the groundwater source area. The groundwater source area is part of the core zone which contains monitoring wells adjacent to the extraction well network.

In the 2007/2008 timeframe, which is when the site was being re-developed, some of these wells (MW2, MW5, MW10, and MW26) experienced a 20 to 30-fold increase in total VOC concentrations. Since November 2015, Total VOC concentrations in the core zone wells MW6, MW7, MW8, MW10, MW11, and MW13 exhibited a “stable/no trend”, “decreasing”, or “probably decreasing” trend (**Appendix F**).

The transition wells MW9, MW15R, and MW26 exhibited “stable/no trend” concentrations since November 2015 according to the Mann-Kendall trend analysis while concentrations in MW4, MW16, compliance point well MW28, MW29, and MW33 showed “decreasing” Total VOC concentrations since November 2015. However, transition wells MW2, MW3, MW5, MW14R, and MW23 exhibited “increasing” Total VOC concentrations since November 2015 likely due to impacts remaining beneath the concrete pads identified in 2019 (e.g., MW2, MW3, and MW5) or fluctuating low concentrations (e.g., MW14R and MW23). It is important to note that Total VOC concentrations in MW14R and MW23 have been less than 25 µg/L since November 2015, therefore, the increasing trend in MW14R and MW23 appears to be subtle.

General Core Zone/Transition Zone observations for this reporting period:

- The majority of monitoring wells representative of the core and transition zones have “stable/no trend”, “decreasing” or probably decreasing” Total VOC concentrations since November 2015.

- As previously discussed, two grab groundwater samples were collected during 2018 soil assessment at locations below each underground concrete pad at GP-2018-46 and GP-2018-50 (**Figure 2**) to obtain an understanding of potential groundwater impacts. Groundwater sample results indicate concentrations of Total VOCs from GP-2018-46 and GP-2018-50 at 37,070 µg/L and 216,868 µg/L, respectively, (**Table 3**) illustrated in **Figure 3**. With respect to transition wells MW2, MW3, and MW5 concentrations of Total VOCs appear to be increasing in these wells due to their location near the concrete pads where soil impacts were observed in the 2018 soil assessment.

- With respect to MW2, MW7, MW10, and MW28, the TCA concentration is “stable/no trend” or “decreasing”, and the degradation products are “increasing” suggesting that abiotic/biotic degradation is occurring. Although the TCA concentration is decreasing in MW2, the 1,4-dioxane and MEC concentrations increased rapidly from the annual event in 2017 to the annual event in 2018.

- With respect to concentrations in Core Zone monitoring wells and referring to May 2019 isoconcentrations for Total VOCs and COCs/COIs (**Appendix H**), it appears that concentrations of COCs/COIs are moving from the groundwater source area in the center of the site primarily toward the west within preferential pathways with remnants of Total VOCs remaining to the east.

4.4.2 Perimeter Zone

The Perimeter Zone wells will be discussed in reference to the east side, west/southwest side, and north side.

East Side

East side perimeter wells (MW1, MW21R, and MW30R) continue to illustrate that plume migration to the east/northeast is limited as concentrations in these wells have never been detected above cleanup goals. Additionally, concentrations of COCs in MW22R, located to the northeast of the source area, have remained below cleanup goals since May 2009.

West/Southwest Side

The west/southwest side perimeter wells include MW25, MW34, MW35, MW36, and MW37. Since November 2015, total VOC concentrations in MW34 and MW37 have been “stable/no trend” or “decreasing” according to the Mann-Kendall trend analysis. Of interest is that concentrations of TCA are decreasing in MW34 perhaps due to abiotic transformation associated with the sanitary sewer. Although TCA concentrations have exhibited an “increasing” trend in MW36, TCA appears to be stable since August of 2017, and Total VOCs show “no trend” since November 2015.

MW25 and MW35 are located along the western property boundary near a utility corridor running along Laburnum Avenue. Unlike Total VOC concentrations in MW36 which can fluctuate, Total VOC concentrations in MW25 and MW35 are “increasing” since November 2015 with TCA, DCA, DCE, and 1,4-dioxane concentrations “increasing” in MW25 and TCA and DCE concentrations “increasing” in MW35. However, Mann-Kendall Trend Analysis indicates that concentrations of COCs/COIs and Total VOCs have exhibited “stable/no trend” since at least November 2016 for MW35. Several factors could contribute to increasing concentrations in MW25 including its location near an intersection of three sanitary sewer lines that may be leaking and/or channeling impacted groundwater along the pipe beds toward MW25.

North Side

The north side concentrations in contingency wells MW50, MW51, MW53, MW54, MW55 and MW56 were discussed in Section 4.3.4. In summary, neither groundwater nor surface water contingency values were exceeded during the reporting period, so the extraction wells along the northern perimeter of the site have remained deactivated during this reporting period. Although concentrations have exhibited a “stable/no trend” for MW51 since at least October 2016, the concentration of DCE (113 µg/L) is near the contingency value for DCE of 150 µg/L, and so additional modeling was performed in the vicinity of MW51 that suggested that EW2 could be activated, if necessary, to control groundwater flow to MW51 without compromising the capture of EW9 and EW18, therefore, minimizing the movement of groundwater along the preferential pathway from the source area to the north along the sanitary sewer utility. It is also possible that other approaches could be used to decrease concentrations near MW51 such as an ISCO injection or potentially an emulsified oil injection. The Total VOCs concentrations have been "stable/no trend" in MW50 since January 2016. Total VOC concentrations remain "stable/no trend" in MW53, MW54, MW55, and MW56 since January 2016.

4.4.3 Overall Groundwater Trend Assessment Summary

In summary, Total VOC concentrations in the core zone, transition zone, and perimeter generally exhibit a "stable/no trend" with the following exceptions:

- Core & Transition: Concentrations in core monitoring wells MW7 and MW8 and transition monitoring wells MW4, MW16, compliance point well MW28, MW29, and MW33 showed "decreasing" Total VOC trends.

- Core & Transition: MW2, MW3, MW5, MW14R, and MW23 exhibited "increasing" Total VOC concentrations since November 2015 likely due to the vicinity of the soil impacts identified during the 2018 soil assessment (e.g., MW2, MW3, and MW5). It is important to note that Total VOC concentrations in MW14R and MW23 have been less than 25 µg/L since November 2015, therefore, the increasing trend in MW14R and MW23 appears to be subtle.

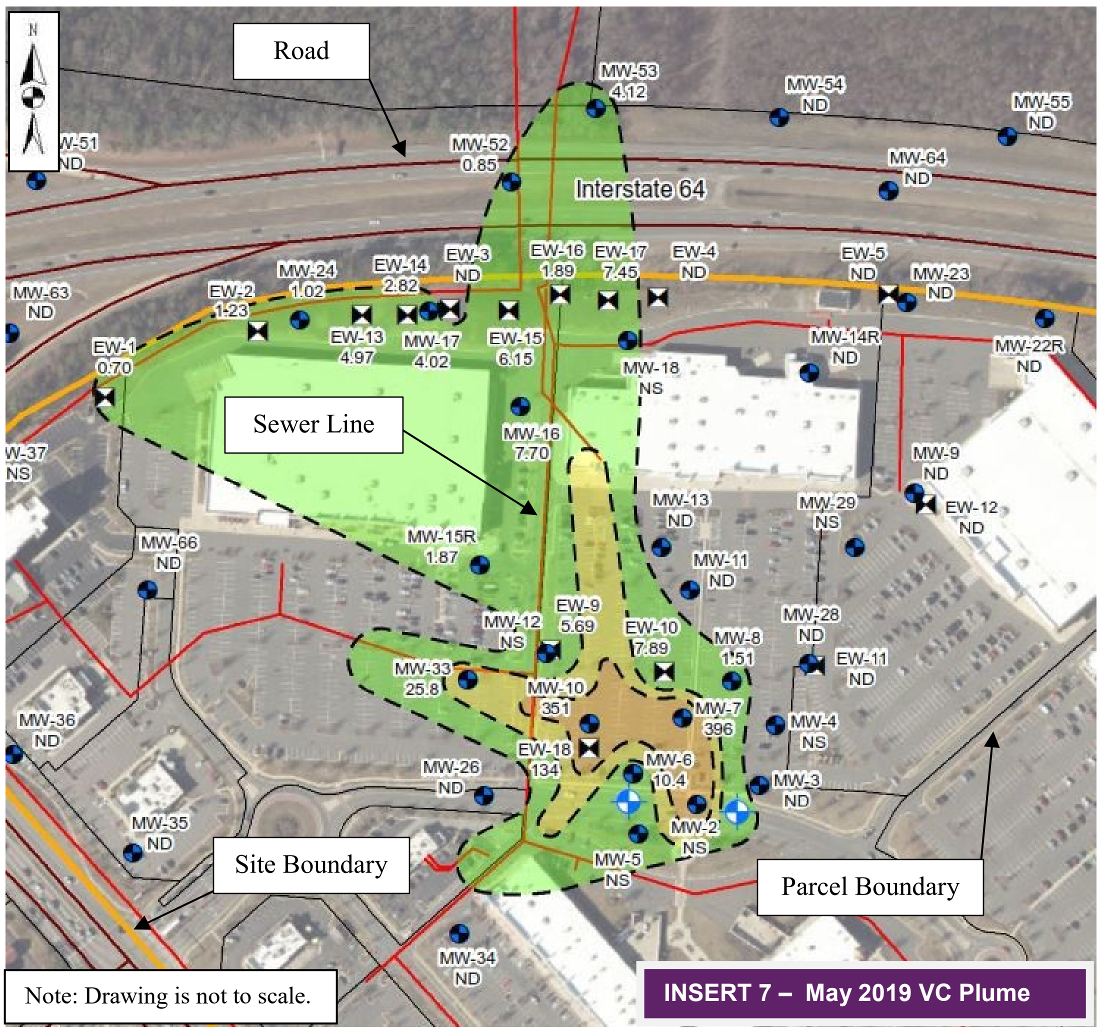
- Perimeter: West side perimeter wells MW25 and MW35 show "increasing" Total VOC concentrations. Total VOC concentrations appear to stabilize in MW35 around November 2016. Although TCA concentrations have exhibited an "increasing" trend in MW36, TCA appears to be stable since August of 2017, and Total VOCs show "no trend" since November 2015. Total VOC concentrations do not appear to be stable in MW25 since November 2015.

- Perimeter: North side perimeter well MW51 shows "increasing" Total VOC concentrations since January 2016. However, Total VOC concentrations in MW51 appear to have been stable since at least October 2016. Total VOC concentrations and COCs/COIs in MW50 now appear to be stable or have no trend since January 2016.

As the groundwater monitoring program continues and extraction well operation remains limited, these wells should continue to be monitored quarterly, and with respect to the contingency wells located directly downgradient from the source area, a contingency action may be required in the future.

4.4.4 Natural Attenuation

It is apparent that natural attenuation with an abiotic/biotic component has been integral in the reduction of groundwater contamination at the site, and that natural processes have supplemented the active groundwater extraction and remediation. Natural attenuation continues to be indicated by the presence of the degradation products of TCA, which can be accounted for by natural processes, including the reductive dehalogenation of TCA in the subsurface. These products include 1,1-DCA, 1,1-DCE, chloroethane, and VC; the latter two from the breakdown of 1,1-DCA and 1,1-DCE. Reductive dechlorination appears to be occurring near the sanitary sewer line as evidenced by the production of VC that occurs at that location (**Insert 7**).



INSERT 7 – May 2019 VC Plume

As an example, historically low nitrate (<0.07 mg/L) and sulfate concentrations (12.3 mg/L) from samples collected in May 2017, and negative oxidation reduction potentials (-204.8 to -21.2 mV) and low dissolved oxygen concentrations (0.10 to 1.85 mg/L) over this reporting period have been observed in MW16 located near the sanitary sewer line suggesting the potential for reductive dechlorination. Groundwater samples were collected from MW16 and MW33 during the August 2017 Biennial reporting period (e.g., August 2016) and submitted to Microbial Insights for qPCR DNA analysis for Dehalobacter spp. and Dehalococcoides spp. Dehalobacter containing culture[4] have been shown to be involved in the biodegradation of TCA through DCA to chloroethane. Dehalobacter spp. (1.04X 10^{1}cells/mL) was detected at low concentrations and chloroethane was detected in MW16 (**Table 2**) suggesting that anaerobic biodegradation is occurring in the vicinity of MW16 and may be enhanced with the addition of an electron donor. Currently, chloroethanes are not detectable in MW33 coinciding that Dehalobacter spp. was not detected in the groundwater from MW33. Dehalococcoides spp. was also detected at low concentrations in the vicinity of both monitoring wells. Dehalococcoides spp. is associated with the biodegradation of VC to ethene. These results suggest that abiotic/biotic mechanisms may be at work at the site at certain locations. Additional evidence of abiotic/biotic mechanisms is supported by Mann-Kendall Trend Analysis showing a “decreasing” Total VOC concentration trend in MW7 and MW28 via “decreasing” concentrations of TCA with simultaneously “increasing” concentrations of DCA, a biodegradation product.

In addition to abiotic/biotic mechanisms, review of recent information regarding the aerobic degradation of 1,4-dioxane and TCA suggest that the aerobic degradation of 1,4-dioxane may be possible in certain areas onsite apart from other areas of the site where anaerobic respiration appears to be occurring. Most recently, the co-metabolic transformation of 1,4-dioxane has been observed in microorganisms that express the ability to use methane and toluene as growth supporting substrates. Because biodegradation is partially dependent on the geochemistry, the presence of organisms, and contaminant concentrations, a groundwater sample from EW15 was submitted to Microbial Insights in February 2018 for CENSUS® qPCR DNA analysis to quantify contaminant degrading microbes through functional genes and assess the potential for aerobic biodegradation of 1-4 dioxane. Although the groundwater is not saturated with dissolved oxygen near EW-15, the dissolved oxygen concentrations appear moderate (5.40 mg/L) and has the potential to support microorganisms capable of co-metabolizing 1,4-dioxane. A groundwater sample from MW34 was also collected and submitted for comparison. The specific genes chosen for analysis include those that produce dioxane tetrahydrofuran monooxygenase (DXMO), soluble methane monooxygenase (SMMO), toluene monooxygenase (RMO), and toluene monooxygenase 2 (RDEG).

Any qPCR results demonstrating high concentrations of the functional genes analyzed suggest in-situ selection, enrichment, and growth of the specific contaminant microorganisms and therefore a greater probability that aerobic bioremediation would be successful. For EW15, the results indicate that microorganisms are present with the capability of producing RDEG and SMMO at concentrations of 2.84E+02 cells/mL and 1.07E+04 cells/mL, respectively. When the genes are expressed, the production of the SMMO and RDEG enzymes signifies co-destabilization of dioxane with the methane (SMMO) and toluene (RDEG) and can be enhanced to treat dioxane-impacted groundwater.

[4] Microbial Insights Website, http://www.microbe.com/chlorinated-ethanes-census

The estimated percentile ranks of the concentrations of RDEG and SMMO genes ranged from 40th to 73rd, respectively. In other words, the concentrations of RDEG and SMMO detected in the EW15 groundwater sample were greater than the concentrations detected in 40% to 73% of all other groundwater samples in the Microbial Insights database where these genes were analyzed and detected above the practical quantification limit (PQL). The concentration of RDEG genes in the EW15 sample could be viewed as modest or "below average" and the concentration of SMMO genes in the EW15 sample could be viewed as "better than average" when compared to the Microbial Insights database. Overall, the "better than average" concentration of SMMO suggests that aerobic biodegradation of dioxane is possible near EW15 likely utilizing methane oxidizing bacteria that produce SMMO and are capable of co-metabolizing dioxane. In addition, it may be possible to bioaugment the groundwater in the vicinity of EW15 with a consortium of microorganisms capable of enhancing the co-metabolism of 1,4-dioxane as well as TCA and associated daughter products.

On the contrary, none of the functional genes were detected in the MW34 groundwater sample, and so, aerobic biodegradation does not appear likely near MW34.

4.5 Groundwater Elevation Summary and Assessment

The following groundwater elevation summary primarily focuses on an evaluation of compliance point monitoring wells MW10, MW17, and MW28, comparing each to adjacent wells and with background monitoring wells. A review of the data indicates that the noted compliance point and background wells are reasonably representative of the groundwater hydraulic conditions for the site. Water levels have historically been measured on a quarterly basis; semi-annual collection of water level data began in May 2000. However, groundwater elevations were collected quarterly during this reporting period in August 2018, November 2018, February 2019, and May 2019 and potentiometric maps are provided in **Appendix E**. Note that increases or decreases refer to changes in groundwater elevation and is sometimes referenced as water level.

The Site is located in a small local watershed that is defined by Gillie Creek to the east and north, a tributary to Gillie Creek to the west, and a drainage divide along the southern perimeter of the property. MW10, MW17, and MW28 are compliance points. The wells historically designated as background wells (MW21R, MW25, MW30R, MW34, MW35, MW36, and MW37) are sufficiently far enough away from extraction well EW9 to account for a slight decrease in groundwater elevations that appeared to occur after the Shut-down Test was initiated in January 2016. The hydrograph for these background wells is shown from 2004 to 2019 (**Figure 15**) and the hydrographs for MW10, MW17, and MW28 are shown in **Figures 16 through 18**, respectively. Due to the surface elevation changes and the well protection procedures implemented during site development, groundwater levels are not available for the October 2007 and May 2008 sampling events.

Prior to 2010, historical groundwater flow was consistently south to north across the site; since 2010, the flow has been generally southeast to northwest. Until that time, the background wells historically tracked in a statistically similar pattern, with wells located in similar areas of the site most closely resembling each other in water level fluctuation as well as relative elevation. Some of these trends changed during the period between 2006 and January 2016, as discussed below.

Looking at historical trends in **Figure 15**, groundwater elevations in monitoring wells MW25, MW36, and MW35 were consistent with historical and typical measurements in November 2008. However, water levels in MW25 and MW36 increased from September 2006 with the demolition of the manufacturing facility. From the demolition to December 2016, the groundwater elevation in MW25 and MW35 increased approximately 5 feet and 3 feet, respectively. However, the groundwater elevation in MW35 experienced a large decrease (5 feet) near the beginning of the demolition but returned to elevations largely consistent with pre-demolition since about May 2010. In comparison with each other, the groundwater elevation in MW36 has a groundwater elevation that is approximately 2 feet higher than that in MW35 even though it is located farther north suggesting water elevations at MW36 may be a result of a leaking sanitary sewer utility and/or preferential pathway. This mounding affect near MW36 may also be associated with lower COCs/COIs concentrations when compared to MW25 and MW35.

Groundwater elevations in representative core well MW10 and transition well MW28 (**Figure 16**) increased by approximately 2 feet from the demolition to December 2015. The groundwater elevation in monitoring well MW30R, an eastern perimeter well, also increased by 2 feet, but is at the groundwater elevation fluctuates around that of MW10 and MW28. In the meantime, groundwater elevations in MW25 (**Figure 17**) have increased to at least five feet above northern perimeters wells MW24 and MW17 which have stayed roughly the same since the demolition and parallel each other. The groundwater elevation in MW25, also located farther north than MW35 or MW36, has the highest elevation of the background wells as is as much as 6 feet higher in elevation lending support to the premise that groundwater is accumulating and Total VOCs are increasing in this area as a result of the intersecting preferential pathways.

With the changes in groundwater flow direction, average water levels in many of the background wells increased significantly from historic levels (1989 to 2009 timeframe). Monitoring wells MW10 and MW28 have increased at least 1 foot above historical averages since 2010. Northwest perimeter wells MW17 and MW24 exhibited the opposite trend since 2010, with water levels approximately 2 feet lower than historical averages for MW24 and MW17. However, water elevations in MW17 and MW24 have increased since January 2016 because the cone of depression around EW14 and EW3 was diminished when these extraction wells were deactivated. Both MW17 and MW24 have "decreasing" concentrations of TCA and Total VOCs according the Mann-Kendall Trend Analysis (**Appendix F**) suggesting that operating EW14 and EW3 may cause TCA concentrations to spread west rather than contract east as the TCA concentrations seem to be doing under limited pumping conditions (e.g., EW9 and EW18 only).

Water levels in other wells also exhibited increases since the demolition, with MW28, MW4, and MW30R increasing by approximately 2 feet (**Figure 18**). After these fluctuations, the groundwater flow changed from north to northwest, and MW25, which is the western-most well on site, shifted to a localized higher elevation than well MW37, which is located slightly east of MW25 and MW36. **Appendix E** contains groundwater contours from 2006 through May 2019.

In summary, changes in groundwater elevations between 2008 and 2010 appear to have shifted the groundwater flow direction from north to slightly northwest, and this observation remained the same within the current reporting period. In addition, it is likely that mounding groundwater at MW36 is due to a preferential pathway associated with the sanitary sewer utility. Groundwater elevations at MW25 have also remained elevated since the demolition and it also appears to be at the end of the sanitary sewer utility extending from the center of the site to the west.

4.5.1 Monitoring Well MW10 Groundwater Elevation Trends

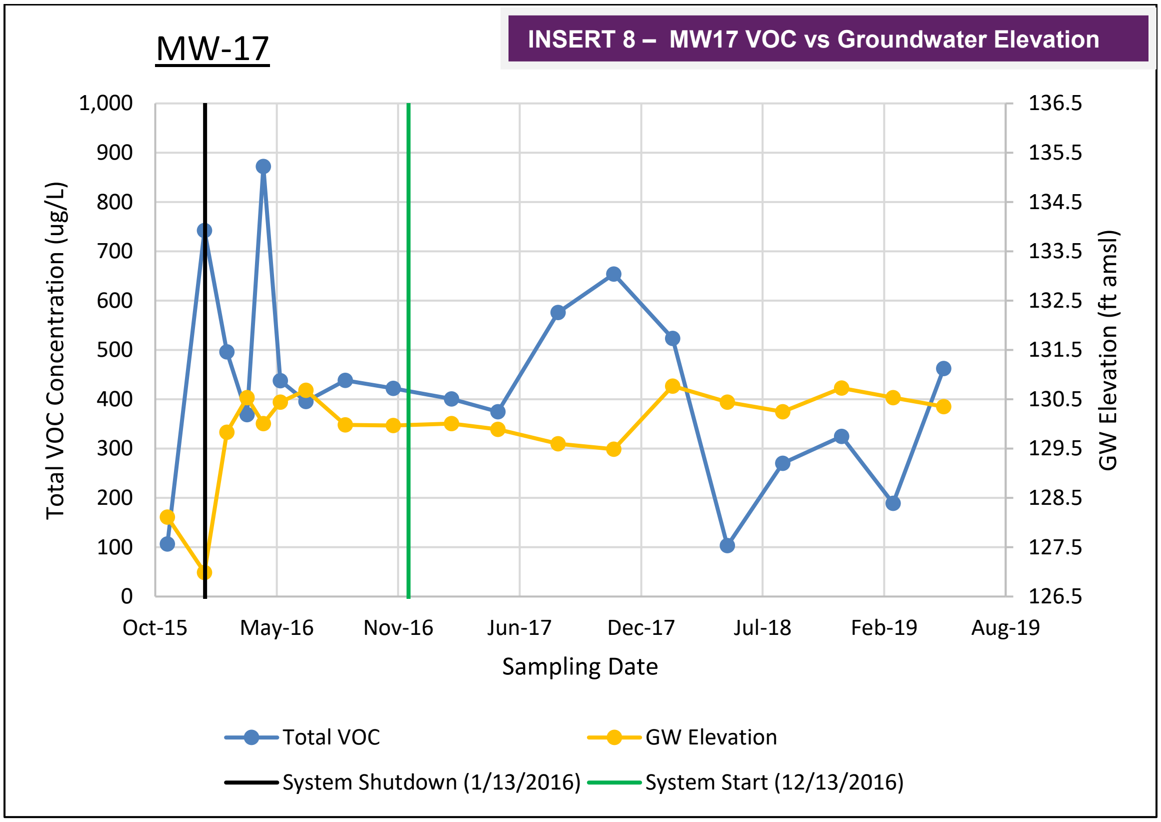
The hydrograph for MW10 is shown in **Figure 16** for comparison with MW28 and MW30R. MW10 is located approximately 60 feet from EW18 and 160 feet from both extraction wells EW9 and EW10. From 2004 until the present, the hydrograph at MW10 is approximately parallel to the hydrograph at MW28. However, around January 2016 when the GWTS was deactivated to begin the Shut-down Test, the groundwater elevations in MW10 and MW28 appear slightly disrupted, but soon become parallel again after the aquifer stabilized. However, elevations decreased slightly after EW9 was reactivated in December 2016. Since February 2017, groundwater elevations in MW10, MW28, and MW30R appear to have an overall increasing trend. Additionally, the groundwater elevation in each well was measured during this reporting period at historical highs since at least 2004. It is important to note that the groundwater elevation measured in MW10 during the February 2018 sampling event (i.e., approximately 142 feet) is likely an anomaly potentially due to the well cap seal failure allowing surface infiltration to influence the groundwater elevation during that time.

4.5.2 Monitoring Well MW17 Groundwater Elevation Trends

The hydrograph for MW17 is shown in **Figure 17** and adjacent well MW24 is also shown for comparison.

In May 2009, the water level in background well MW25 increased to a level of approximately 4 feet above its historical average, while the levels in MW17 and MW24 decreased to their lowest historical levels in May and October 2009. Water levels in MW25 have continued to be at least 5 feet above historical levels since 2010. MW25, which is the western-most monitoring well on the site, is located behind the hotel that was constructed during 2008 and 2009. Localized runoff from the parking lot and adjacent areas, groundwater accumulation along preferential pathway, could be potential reasons for the increase in groundwater elevation and change in general site flow direction towards the northwest. As such, groundwater flow to the west appears limited because of the general groundwater elevation increase along the western perimeter of the site.

As noted above, the water levels in MW17 and MW24 have been approximately 2 feet lower than historical average water levels since 2010 until the GWTS was deactivated in January 2016 when groundwater elevations increased by 2 feet. From **Insert 8** below, it appears that groundwater elevations and Total VOC concentrations in MW17 stabilized in approximately June 2016 but become disrupted after May 2017. The disruption between groundwater elevations and Total VOC concentrations are likely due to seasonal fluctuations within the northerly preferential pathway.



4.5.3 Monitoring Well MW28 Groundwater Elevation Trends

The MW28 hydrograph is included as **Figure 18** and nearby wells MW4 and MW30R are also shown for comparison. Since 2010, water levels in MW28 and MW4 have been approximately one foot to 2 feet higher than the historical average. However, the groundwater elevation in MW28, MW4, and MW30R appear to parallel each other since January 2016. Coinciding with the trend noted in Section 4.5.1, the groundwater elevation in each well was measured during this reporting period at historical highs since at least 2004.

4.5.4 General Groundwater Elevation Trends

Groundwater potentiometric maps covering the period from August 2017 to May 2019 are provided in **Appendix E**. Groundwater elevations are annotated adjacent to each monitoring well. The pumping influence from EW9 and EW18 is not actively shown on these figures.

In general, the historical groundwater contour maps showed a consistent south-to-north groundwater flow pattern across the site between 1989 and 2009. However, since 2010, the flow has been generally southeast to northwest. Groundwater mounding along the western property boundary seems to limit groundwater flow due west. In September and October 2006, a sediment basin was constructed adjacent to the perimeter of the site, between monitoring wells MW16, MW17, and MW18. As seen in the groundwater contour map from the April 2007 sampling event, this basin apparently caused a localized mounding effect at MW18 due to infiltration of the standing water in the basin. Conversely, a localized depression has formed around MW13 and MW14. Buildings/structures and pavement throughout the site were demolished between January and September 2007, and the sediment basin was filled in September 2007. These activities resulted in localized effects on the groundwater contours, as shown in the November 2008 and May 2009 groundwater contours (**Appendix E**).

The movement of water along the preferential pathways appears dependent on the amount of rainfall where increased rainfall causes mounding in the center of the site due to infiltration and numerous utilities which may transfer water to the area via pipe bedding or leaky piping (e.g., stormwater or sanitary sewer utilities). This mounding appears to push water along the preferential pathways to the west and occurs somewhat seasonally. Once impacted groundwater reaches the western perimeter, it appears to move along the utility corridor to the north, and pool in the vicinity of MW25 contributing to increasing concentrations in that area. However, after the groundwater pools at MW25, the natural groundwater flow conditions appear to re-establish. Extraction well EW18 is located near this preferential pathway and it has been pumping in conjunction with EW9 to help reduce source area concentrations and limit the movement of COCs/COIs toward the western perimeter.

Historically, AECOM conducted a comprehensive 72-hour aquifer test at the site in June 1999. Based on the drawdown and reciprocal response data, the anticipated radius of influence of an extraction well along the perimeter pumping at 5 gpm was estimated at approximately 125 to 160 feet.

5.0 OPERATIONS AND MAINTENANCE OF TREATMENT SYSTEM

5.1 Mass Removal Evaluation

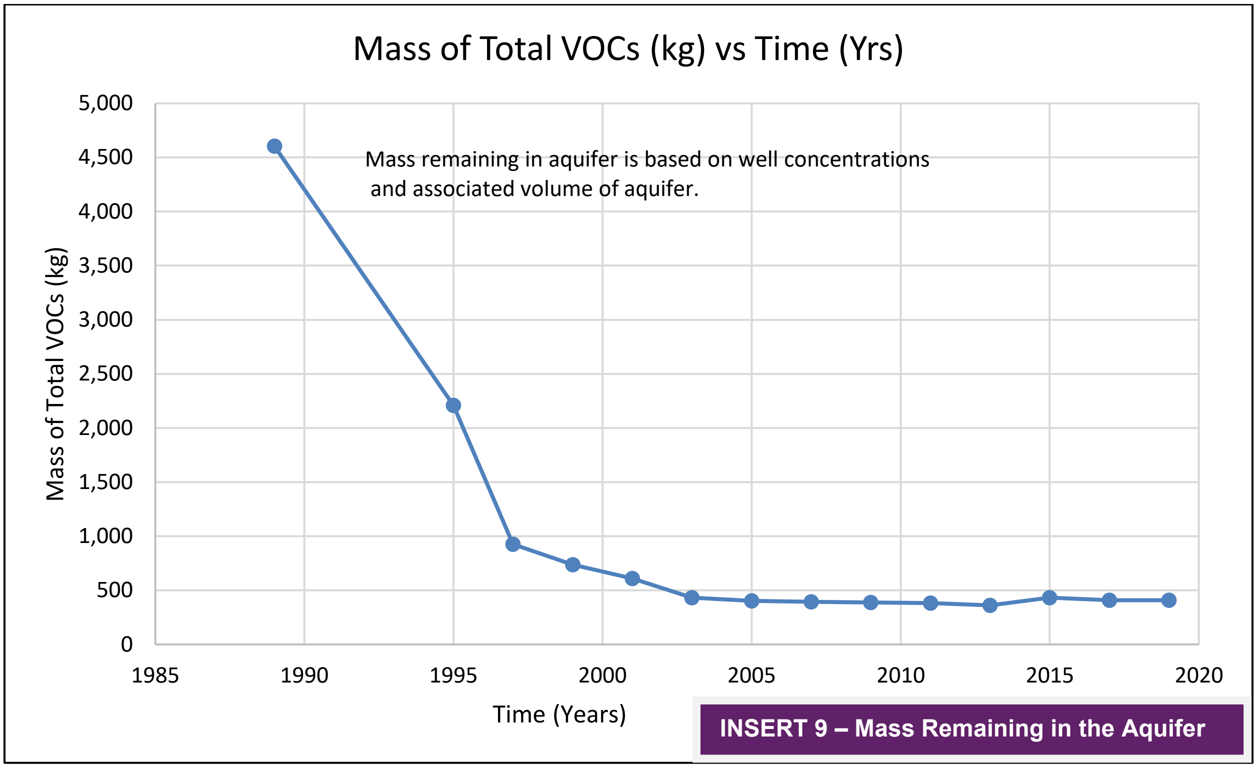
In examining the maximum VOC concentration trends in individual monitoring wells as presented in Historical Biennial Reports, it was noted that a single well was often reported at an anomalously high concentration. Since 2011, the monitoring wells with the higher concentrations are usually MW7, MW10, or MW33. The wells with the second and third highest total VOC concentrations were compared, and found to exhibit a trend that more closely represents the site-wide trends. Therefore, for the purposes of this analysis, the second highest concentration in each calendar year was used for comparison purposes, with the exception of 2008, when the third highest concentration was used. Due to the development work described above, a localized increase in contamination was observed at (EW18 and MW10) during the 2008 sampling events, so the third highest well (MW12) is most representative for that year.

As displayed in **Table 14**, the second highest VOC concentration in any individual monitoring point decreased 44% from 1989 to 1995, with an additional decrease of over 98% since the treatment system began operation. The second highest total VOC concentration observed during the last sampling event (May 2019) was only 1.9 % of the second highest concentration measured in 1989, and the highest concentration has decreased to 0.6 % of the 1989 level. Note that 2nd highest VOC concentrations decreased from 2003 to 2005, then spiked up in 2006 to 8,561 µg/L, and has been fluctuating between 3,919 µg/L and 9,710 µg/L since 2006 and inclusive of the current reporting period.

Based on the flow rate through the treatment system, mass removed by each extraction well, and air stripper influent analytical results, an estimate of mass removal was calculated. **Table 15** shows contaminant mass removal and removal efficiency from the aquifer for each year that the system has been operating. Because this reporting period includes limited pumping of the GWTS where 16 of the 18 extraction wells were not in operation, the volume of groundwater removed was lower than historical reporting periods. The mass removal efficiency for EW9 and EW18 when in operation for approximately 24 months was 8 kg/MGal. The mass removal efficiency for EW9 and EW18 during this reporting period is greater than or equal to mass removal efficiencies since 2003 and during times where all 18 extraction wells were utilized at least partially during the reporting period, indicating that it is more efficient to address the source area when considering mass removal.

In addition, the total mass of VOCs in the groundwater has been estimated at various time frames to monitor relative changes in plume mass. The mass of VOCs remaining in the aquifer was estimated using VOC concentrations representative from each zone and an estimated volume of the plume contours. The area of the plume was estimated using GIS software, using a saturated zone thickness of 13 feet and an assumed porosity of 40% (accounts for sand and gravel mix plus silt layers observed at the site) to estimate the volume of water in each contour. The results can be compared to determine the relative decrease in plume contaminant mass over various time periods, as illustrated in **Table 16**.

When comparing the total amount of mass removed by the GWTS in 2019 (132 kg) summarized in **Table 15** with the amount of mass estimated to remain in the aquifer in 2017 (409 kg) in **Table 16**, it is likely that residual soil contamination within aquifer media of the source area is continuing to contribute to aquifer mass. In addition, after the discovery of newly identified mass in vadose zone soil in 2017 and 2018, and total VOCs in groundwater in excess of 100,000 µg/L beneath the concrete pads, the current and historical amount of mass remaining in the aquifer was revised to include the additional mass (**Table 16**). **Figure 14** shows the new 100,000 µg/L and 10,000 µg/L Total VOC contours from May 2019 that contribute to the increase of mass in the aquifer. **Table 16** also indicates that 91% of the mass originally estimated to be in the aquifer has been removed compared to the mass prior to system startup (1989). Despite the operation of the GWTS for over 20 years, the amount of mass remaining in the aquifer has remained largely stable since approximately 2005 (**Insert 9** below) even though the GWTS system has removed an average of 80 kg per reporting period since 2009. This may be partially attributed to the movement of VOC mass from vadose zone soil within the source area and beneath the concrete pads into groundwater.



INSERT 9 – Mass Remaining in the Aquifer

6.0 OPERATIONS AND MAINTENANCE OF TREATMENT SYSTEM

6.1 Operational Data and Performance Assessment

6.1.1 Groundwater Extraction System

The GWTS was placed in service on February 21, 1995, and later upgraded with additional extraction wells in 1999 and 2000, as previously described. The VER was also implemented in October 2000. The GWTS and its infrastructure were relocated between March and July 2007.

A total of 2,539,767 gallons were pumped and treated by the system during the reporting period (June 2017 to May 2019), producing an average flow of 4.4 gpm while pumping, as shown in **Table 17**. The average flow was less than what is typical because two extraction wells (i.e., EW9 and EW 18) this entire reporting period rather than 18 extraction wells as was typical historically.

Maintenance was performed to remove iron and other deposits from EW9 and EW18 during the reporting period. Iron fouling has historically affected the well screens, pump motors, and occasionally the riser piping, decreasing the efficiency of the wells and thus producing lower flow rates. The fouling has been determined to be primarily due to oxidation of iron in the groundwater. The fouling is manifested as a hard mass formation on surfaces such as the well screen, pumps, and transducers, rather than the gelatinous fouling that is typically indicative of iron bacteria. The oxidation process typically occurs within the formation, prior to the groundwater reaching the recovery wells. There is generally little that can be done to impede the ferrous iron from adhering to the well screen and downhole equipment.

6.1.2 Air Stripper

The original GWTS used a 60-foot-high, packed column air stripper that had been retrofitted from solvent recovery to groundwater treatment when the system was constructed in 1997. The relocated GWTS uses a new low-profile air stripper, which has the following specifications:

- 99.9% design removal of target VOCs at 100 gpm flow rate
- Four removable trays for easy maintenance access
- 7.5-HP blower designed to provide 100 cfm airflow at 12 psi pressure
- 75-gallon collection sump
- Float level switches in sump to control discharge pump, and
- ½-HP discharge pump rated at 100 gpm at 5 feet of head.

Effluent samples were obtained quarterly to gauge the performance of the air stripper; these samples are also used to satisfy the requirements of the Henrico County Industrial Discharge Permit. Effluent Total VOC concentrations have never exceeded the discharge limitations specified in the SAP (10 times the ROD cleanup goals) or the Total Toxic Organics specified by the Henrico Country discharge permit. The air stripper trays were last dismantled, scraped, and pressure washed, and all air holes were reamed/cleaned in April 2018. Influent and effluent samples collected during the May 2017 sampling event indicated that the air stripper obtained a removal efficiency of 86%, exclusive of 1,4-dioxane. Subsequently, the air stripper was cleaned of iron fouling. The Henrico TTO discharge limit (2.13 mg/L) was achieved prior to treatment at 1.17 mg/L.

An air stripper is not designed to remove 1,4-dioxane, therefore during the May 2017 sampling event, 1,4-dioxane (SIM) was detected in the influent (138 µg/L) and effluent (136 µg/L). The constituent 1,4-dioxane is not required under the Henrico County Industrial Discharge Permit and is typically not included for laboratory analysis of effluent samples.

6.1.3 Vapor-Phase Carbon Adsorption System

One 2,000-pound, vapor-phase granular activated carbon (GAC) unit treats the air discharge from the air stripper, and a separate 2,000-pound, vapor-phase GAC unit treats the air discharge from the LRP. Both units are rated at 900 cubic feet per minute (cfm) under 10 pounds per square inch (psi) pressure. Each unit has a separate discharge to the atmosphere through a stack protruding through the roof of the GWTS building. The vapor-phase carbon units were last changed in the first quarter of 2014. Vapor-phase carbon adsorption units typically operate at over 99% removal efficiency.

6.1.4 Vacuum-Enhanced Recovery (VER) System

In 2000, a VER system was implemented on source area wells EW9, EW10, EW11, EW12, and EW18. Using a high-vacuum LRP in conjunction with a submersible well pump, VER is commonly utilized to enhance liquid-only pumping in the following ways:

- Increase net effective drawdown and thus increase groundwater extraction rate,
- Increase capture zone/radius of influence of well,
- Facilitate volatilization within previously saturated soils, and
- Enhance aerobic biodegradation by increasing oxygen flow through the subsurface.

The VER may have contributed to the mass contaminant removal from groundwater as well as soil. However, the mass removal effectiveness of the VER system cannot be separated from the effectiveness of pumping in the source area. The VER system was not operated during this reporting period or since 2013. The LRP is prone to downtime and will require an upgrade to operate for an extended period.

6.2 Maintenance Summary

6.2.1 Extraction Wells, Pumps, and Transducers

Maintenance as required has been implemented for the problem wells, to maintain well pumping efficiency. Pumps and level transducers were routinely removed from the wells, cleaned, and replaced, if necessary.

Lightning strikes and flooding conditions within the extraction well vaults have periodically damaged or destroyed level transducers in the extraction wells, requiring periodic replacement of the equipment and electrical connections. Water level transducers have also been replaced periodically due to short service life, and well pumps and motors are replaced as they wear out. During the two-year reporting period, at least three motors, three pumps, and two-level transducers were replaced in EW9 and EW18 for the GWTS. The motor and pump replacement often came from exiting unused pumping wells. Control panel repairs and welding repairs to the air stripper were also completed.

Other general maintenance has been performed as necessary; specific maintenance issues are reported in the Bi-Monthly Update Reports to EPA.

6.2.2 Vacuum-Enhanced Recovery (VER) System

The LRP for the vacuum recovery system was repaired on August 11, 2011. The condenser, which was found to be full of water, was drained, and the level switch cleaned. The LRP vacuum pressure was subsequently increased on August 31, 2011, as the extraction flow rates and the groundwater table had increased during this period due to high levels of rainfall. The LRP was also serviced in January 2013 to increase the vacuum pressure. The LRP is prone to downtime and will require an upgrade to operate for an extended period. The VER system was not operated during this reporting period.

6.2.3 Air Stripper

A low-profile air stripper was installed as part of the GWTS relocation process in 2007. In April 2018, the air stripper was dismantled, scraped, and pressure washed, all air holes were reamed/cleaned, and the stripper was reassembled to increase airflow performance and thus VOC removal efficiency. The inlet and outlet for the air stripper blower and piping to the air stripper was also cleaned in April 2018.

6.2.4 Vapor-Phase Carbon Canisters

Two vapor-phase carbon units were installed with the relocated GWTS; these units have not required maintenance since that time. The activated carbon in these units was replaced in first quarter of 2014.

6.2.5 Other Equipment and Piping

Minimal preventive maintenance has been required for the pumps, tanks, and system piping. The wiring for the extraction well pumps within the well sumps has been repaired or replaced as it wears due to age.

In February 2012, the Henrico County Department of Public Utilities replaced the discharge flow meter with a model that could be read remotely. Henrico County replaced their flow meter in November 2015.

7.0 DISCUSSION/CONCLUSIONS

7.1 Soil Assessments

Based on the review of historical reports provided by the previous consultant, developer's consultant, and EPA, and results from the 2017 soil assessment, a total of 37 soil borings were advanced at the site near former manufacturing structures, Building 51, Building 33, the Former Tank Farm, and beneath the concrete pads to further assess areas of vadose zone soil impacts remaining in the subsurface that may be contributing to the mass transfer of contaminants to groundwater and a resultant ongoing degradation of groundwater quality. This assessment work was performed in October 2018.

To verify total field results, 37 soil samples were sent to Air, Water, and Soil Laboratories, Inc. for analysis of VOCs according to SW Method 8260B. Additionally, two groundwater samples were collected during this soil assessment at locations below each underground concrete pad to obtain an understanding of potential groundwater impacts, and sent to Air Water, and Soil Laboratories, Inc. for analysis of VOCs according to SW Method 8260B. Groundwater results from these two locations may be different if collected from a permanent monitoring well, therefore, the groundwater results are used for comparative purposes only.

A soil assessment was also performed in 2017 and reported in the previous Biennial Report. The 2018 assessment refined work performed in the 2017 assessment, so for overall clarity, the following paragraphs summarize observations of the 2017 and 2018 soil assessments:

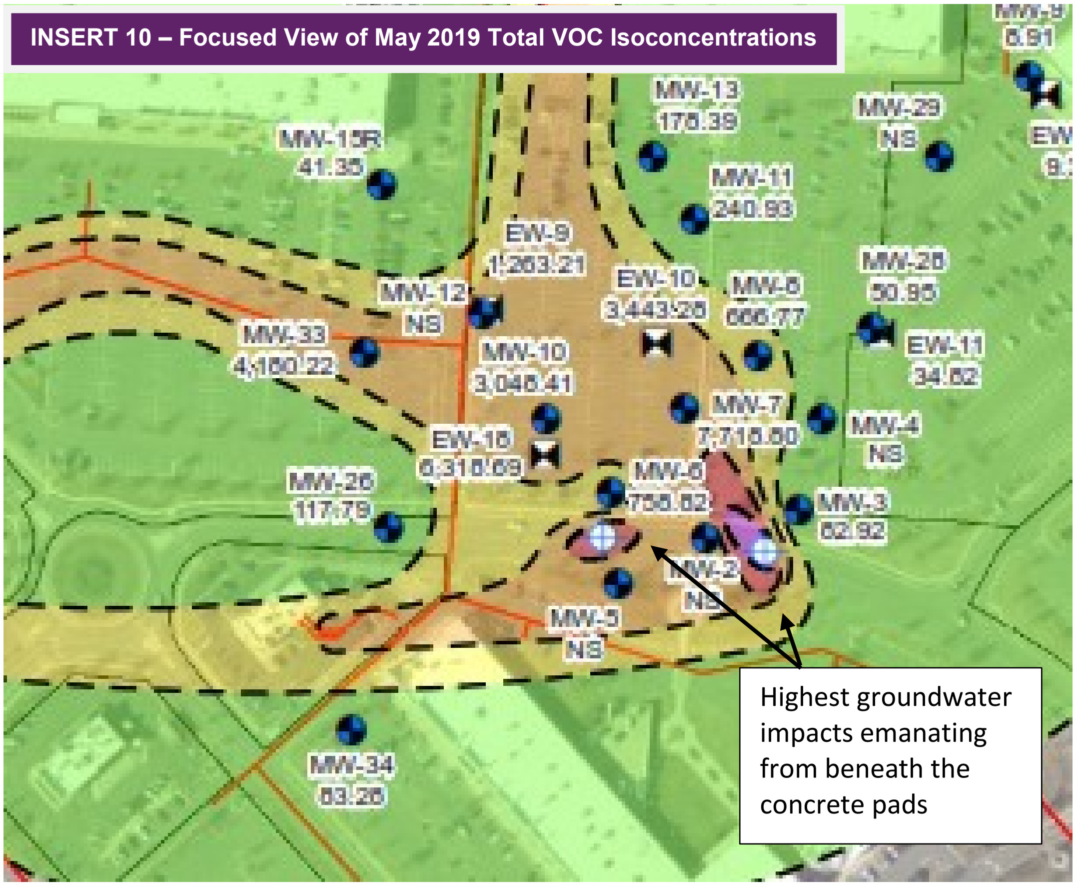
- Constituents such as TCA, MEC, and 1,4-dioxane are present at substantially elevated concentrations in the vadose zone near the locations of factory buildings (Buildings 51 & 33) and the Tank Farm. Because these constituents are not degradation products, but instead were present in chemicals used in the manufacturing process and are found close to historical factory activities, these high concentrations indicate historical releases and a primary source of impacts to groundwater rather than a result of matrix effects.

- The impacts, particularly beneath the concrete pads, extend from depths of approximately 7 feet below land surface to the depth of the groundwater-soil interface or smear zone.

- Groundwater impacts beneath the concrete pads are the highest total VOC concentrations measured at the Site to date.

- Clay is the predominant soil type from the land surface to the depth of groundwater at approximately 15 to 20 feet below land surface. Particularly in areas of historically high COC concentrations in groundwater, it is possible that VOCs have been introduced to previously unimpacted areas of clay along the groundwater interface, creating "matrix effects" where the clay provides a continual source of residual VOCs to groundwater over larger areas of the site. This matrix effect may be contributing to the stable mass of VOCs remaining in the groundwater year after year, <u>and is a separate condition from vadose zone soil that has been impacted as a direct result of a release.</u>

As illustrated by the May 2019 Total VOC isoconcentrations in **Insert 10** below, the groundwater samples collected beneath the concrete pads show that vadose zone soil impacts from beneath the pads have contributed to groundwater contamination because the highest groundwater concentrations present at the Site today emanate from beneath the concrete pads.



To target vadose soil with the greatest VOC mass and representative of a release, areas were identified that meet the following criteria: 1) concentrations of TCA, MEC and 1,4-dioxane, (constituents of chemicals used in the manufacturing process), that are 100 times the EPA Protection of Groundwater Site Screening Levels (SSLs) or greater, 2) beneath former structures, 3) beneath concrete pads, and/or 4) believed to be void of utilities. Target concentrations at 100 times the SSL are 28,000 µg/kg for TCA, 270 µg/kg for MEC and 9.4 µg/kg for 1,4-dioxane. These areas are shown in **Figure 3.** According to the EPA's *Soil Screening Guidance: Technical Background Document* (EPA, 1996), EPA SSLs are estimated based on a dilution factor of the Maximum Contaminant Levels that estimates the concentration of soil leachate that could conservatively impact groundwater. Wood is not targeting all areas of soil that could possibly impact groundwater. For example, Wood is not targeting areas of lower-concentration soil that may re-contaminate groundwater due to matrix effects, but only areas of high vadose zone soil concentrations likely resulting directly from historical releases.

7.2 Environmental Monitoring

Groundwater monitoring occurred with a frequency according to the ROD with additional monitoring performed with a frequency according to the Interim Next Steps of the August 2017 Biennial Report and as shown in **Table 1**. The following summarizes the conclusions regarding monitoring performed during this reporting period:

7.2.1 Preferential Pathways

- The movement of COCs/COIs to the north and west is influenced by the sanitary sewer line running centroid to the site as reported historically.

- The movement of COCs/COIs to the north and west, particularly 1,1-DCE and 1,4-dioxane, near the western property boundary is likely influenced by the sanitary sewer lines running from the center of the groundwater plume and to the west. This is visually illustrated by the May 2019 1,4-dioxane isoconcentration map in **Appendix H**. Total VOC concentrations in west side perimeter wells MW25, MW35, and MW36 have indicated increasing trends. Total VOC concentrations appear to stabilize in MW35 around November 2016 while Total VOC concentrations in MW36 appear to fluctuate seasonally between stable/no trend and increasing trends based on groundwater elevation fluctuations within the source area. However, TCA, DCA, DCE, 1,4-dioxane, and Total VOC concentrations in MW25 do not appear to stabilize within this reporting period.

- The movement of water along the preferential pathways appears dependent on the amount of rainfall where increased rainfall causes mounding in the source area due to infiltration and numerous utilities which may transfer water to the area via pipe bedding or leaky piping (e.g., sanitary sewer utilities). Record rainfall was recorded for Richmond in 2018. This mounding within the source area appears to push water along the preferential pathways to the west and occurs somewhat seasonally.

- Once impacted groundwater reaches the western perimeter, it appears to move along the utility corridor to the north, and pool in the vicinity of MW25 contributing to increasing concentrations in that area. However, after the groundwater pools at MW25, the natural groundwater flow conditions appear to re-establish.

7.2.2 Groundwater and Surface Water

- The mass of Total VOCs remaining in the aquifer has remained fairly consistent since 2003, even though large amounts of water have been removed by the GWTS.

- Historically, groundwater flow direction has been predominantly toward the north. However, the limited/non-pumping conditions illustrate that the groundwater flow direction has shifted primarily northwest, suggesting that the natural groundwater flow is towards the northwest.

- Increased groundwater elevation along the western property boundary tends to limit groundwater flow to the west.

- Similarly, the central axis of the contaminant plume under limited/non-pumping conditions lies largely to the north-northwest with remnants (e.g., detections below the clean-up goals), remaining in some wells to the east.

- Groundwater elevations appear to have stabilized in most monitoring locations since the Summer of 2016. However, an increase of groundwater elevation since 2016 is most noticeable near MW17 and MW24 at the north perimeter. These wells are close to extraction wells. Both MW17 and MW24 have "decreasing" concentrations of TCA and Total VOCs according the Mann-Kendall Trend Analysis suggesting that operating EW14 and EW3 may cause TCA and Total VOC concentrations to spread west rather than contract east as COC/COI concentrations seem to be doing under limited pumping conditions.

- With respect to transition wells MW2, MW3, and MW5 concentrations of Total VOCs appear to be increasing in these wells potentially due to their location near the concrete pads where soil impacts were observed in the 2018 soil assessment. Note that record rainfall occurred in 2018 and may have contributed to increased concentrations through infiltration or potentially leaky storm water lines that are located beside the mall road.

- Surface Water: After April 2012, VOC concentrations appear stable inclusive of this reporting period. COCs/COIs were not detected in the surface water samples above the reporting limit during this reporting period.

7.2.3 Contingency Wells

- Groundwater or surface water contingencies were not exceeded for the trigger water samples, so the contingency has not been activated to date.

- Total VOC concentrations in MW50, MW53, MW54, MW55, MW56, and SW67, located east of the centroid sanitary sewer utility are stable or have no trend.

- Mann-Kendal trend analysis suggest increasing concentrations of total VOCs in MW51 since January 2016. However, total VOCs in MW51 appear to have stabilized since October 2016, respectively.

- COCs/COIs were not detected above the reporting nor method detection limits in the surface water samples collected from SW67.

7.2.4 Compliance Wells

- Concentrations of COCs/COIs in compliance monitoring wells (i.e., MW10, MW17, and MW28) show either stable, no trend, probably decreasing or decreasing trends since January 2016 except for the DCE and VC (MW10) and DCA (MW28) concentrations which are "increasing". The DCE and DCA concentrations in MW10 and MW28, respectively, may be increasing due to their location near the vicinity of EW9 and EW18; both of which have been active since December 2016. Regarding VC in MW10, concentrations may be increasing because of the well's proximity to the sanitary sewer utility corridor. Fluids escaping the sanitary sewer line may be acting as an electron donor and enhancing anaerobic biotic/abiotic processes. In addition, total VOCs are decreasing (MW17 and MW28) or stable/no trend (MW10) in these compliance wells.

7.3 Natural Attenuation

- DCE and DCA (degradation products of TCA) are found throughout the monitoring well network, especially from the source area toward the northwest perimeter.

- Anaerobic chemical transformation of TCA to DCE and the anaerobic reductive dechlorination of DCE to VC appears to be occurring near the sanitary sewer utility that runs from the source area north to the wetland. Near anaerobic conditions are likely in this area because of organic carbon potentially leaking from the sanitary sewer.

- Aerobic biodegradation of 1,4-dioxane is possible near EW15 likely utilizing methane oxidizing bacteria that are capable of co-metabolizing 1,4-dioxane. In addition, it may be possible to bioaugment the groundwater in the vicinity of EW15 with a consortium of microorganisms capable of enhancing the co-metabolism of 1,4-dioxane as well as TCA and associated daughter products. However, aerobic biodegradation does not appear likely near MW34.

- MW7 and MW28 show evidence of biotic/abiotic degradation processes illustrated by "stable/no trend" or "decreasing" TCA concentrations with increasing degradation products. MW7 and MW28 are NOT located near a sanitary sewer line.

7.4 GWTS Operation and Maintenance

The GWTS operated from June 2017 to May 2019, with the operation of EW9 and EW18.

- Extraction wells EW9 and EW18 are located near preferential pathways and have been pumping in conjunction with one another during this reporting period to help reduce groundwater concentrations in the center of the site and limit the movement of COCs/COIs toward the western perimeter.

- The mass removal efficiency for EW9 and EW18 when in operation for approximately 24 months was 8 kg/MGal. The mass removal efficiency for EW9 and EW18 during this reporting period has increased two-fold since 2003 when all 18 extraction wells were utilized or partially utilized indicating that it is more efficient to address the source area when considering mass removal.

- MW17 and MW24 have "decreasing" concentrations of TCA and Total VOCs according the Mann-Kendall Trend Analysis with increasing groundwater elevations suggesting that operating EW3 and EW14 may cause low TCA concentrations to spread west unnecessarily.

- The GWTS has been in operation for over 20 years and continues to experience malfunctions in equipment due to age. Over the time of operation in this reporting period, iron fouling limited transducer and pump life.

- Six environmental covenants have been agreed upon and recorded, which cover parcels owned by BRE DDR BR White Oak VA LLC (Office Max and the rest of the White Oak Village), GMRI Inc. (Olive Garden), Rare Hospitality International, Inc. (Longhorn), Lowe's Home Centers LLC (Lowe's Home Improvement), Oak LLC (Hyatt), and Target. The requirement to obtain environmental covenants for Red Lobster and Steak & Shake, after best efforts by LSI, was vacated by USEPA per emails dated 27 February 2018 and 25 July 2018. Environmental covenants were not needed for Sam's Club and Panera Brad parcels of the facility per USEPA letter dated 23 February 2016.

8.0 RECOMMENDATIONS

A Technical Memorandum is currently being prepared to propose the "Next Steps" for the LSI Site, and will be delivered under a separate cover. However, Wood recommends the following interim steps while the Technical Memorandum is prepared.

- Since Total VOC concentrations are generally "Stable/No Trend" east of the sanitary sewer line running to the north, we recommend extraction wells EW4, EW5, EW6, EW7, EW8, EW11, EW12, and EW17 remain out of service to avoid moving contaminants to the east.

- Continue quarterly monitoring as described in the 2017 Biennial Report and described in **Table 1** for calendar year 2018. It is also recommended that MW2 and MW5 be sampled semi-annually instead of annually.

TABLES

Table 1
Environmental Monitoring Locations and Frequency
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Sample Location	2017		2018				2019	
	August	November	February	May	August	November	February	May
On-Site Monitoring Wells								
MW1		X				X		
MW2		X				X		
MW3 - Transition	X	X	X	X	X	X	X	X
MW4		X				X		
MW5		X				X		
MW6 - Core	X	X	X	X	X	X	X	X
MW7-core	X	X	X	X	X	X	X	X
MW8-Core		X		X		X		X
MW9 - Transition		X		X		X		X
MW10*- Compliance Point, Core Zone near former solvent tank	X	X	X	X	X	X	X	X
MW11 - Core	X	X	X	X	X	X	X	X
MW12		X				X		
MW13		X		X		X		X
MW14R - Transition	X	X	X	X	X	X	X	X
MW15R		X		X		X		X
MW16 - Transition	X	X	X	X	X	X	X	X
MW17*- Compliance Point - Perimeter Zone	X	X	X	X	X	X	X	X
MW18		X				X		
MW21R		X				X		
MW22R - Perimeter		X		X		X		X
MW23 - Transition	X	X	X	X	X	X	X	X
MW24 - Transition	X	X	X	X	X	X	X	X
MW25 - Perimeter	X	X	X	X	X	X	X	X
MW26		X		X		X		X
MW28* - Compliance Point ,Transition Zone, Source Area Well	X	X	X	X	X	X	X	X
MW29		X				X		
MW30R		X				X		
MW33 - Transition	X	X	X	X	X	X	X	X
MW34 - Perimeter	X	X	X	X	X	X	X	X
MW35	X	X	X	X	X	X	X	X
MW36 - Perimeter	X	X	X	X	X	X	X	X
MW37		X				X		
MW66	X	X	X	X	X	X	X	X
Off-Site Monitoring Wells								
MW31		X				X		
MW32		X				X		
MW50	X	X	X	X	X	X	X	X
MW51	X	X	X	X	X	X	X	X
MW52 - Perimeter	X	X	X	X	X	X	X	X
MW53	X	X	X	X	X	X	X	X
MW54	X	X	X	X	X	X	X	X
MW55 - Perimeter	X	X	X	X	X	X	X	X
MW56	X	X	X	X	X	X	X	X
MW62 - Perimeter	X	X	X	X	X	X	X	X
MW63		X		X		X		X
MW64		X		X		X		X
MW65		X		X		X		X
Extraction Wells								
EW1		X		X		X		X
EW2		X		X		X		X
EW3		X		X		X		X
EW4		X		X		X		X
EW5		X		X		X		X
EW6		X		X		X		X
EW7		X		X		X		X
EW8		X		X		X		X
EW (DPE) 9 - Core	X	X	X	X	X	X	X	X
EW (DPE) 10	X	X	X	X	X	X	X	X
EW (DPE) 11 - Transition	X	X	X	X		X		X
EW12 - Transition	X	X	X	X	X	X	X	X
EW13		X		X		X		X
EW14		X		X		X		X
EW15		X	X	X	X	X	X	X
EW16		X		X		X		X
EW17		X		X		X		X
EW(DPE) 18 - Core	X	X	X	X	X	X	X	X
Surface Water (Compliance Points)								
SW15	X	X	X	X	X	X	X	X
SW20		X		X		X		X
SW21	X	X	X	X	X	X	X	X
SW67 (Modern)	X	X	X	X	X	X	X	X
Number of Locations Sampled	**August**	**November**	**Februrary**	**May**	**August**	**November**	**February**	**May**
	33	**68**	**34**	**56**	**33**	**68**	**33**	**56**

Completed By: David Young Date: June 11, 2019 Checked By: Forrest Hayward Date: June 13, 2019

Table 2
Former AT&T Richmond Works Facility
Surface Water and Groundwater Monitoring Results, ug/l
Baseline Data for Shutdown begins in January 2016

Location	Date Sampled	1,1-DCA	1,1-DCE	MEC	1,1,1-TCA	1,4-Dioxane	Vinyl Chloride	TOTAL VOCs	Chloro-ethane	Chloroform	PCE	TCE	Other VOCs
Clean-up Goal, µg/l	mm/dd/yyyy	4	7	5	200	NA	NA	--	NA	NA	NA	NA	NA
Pilot Test Wells													
P-1	12/16/2015	**353**	**3310**	1.76 J	**1750**	1150	1.94	6573.05	ND	1.31	0.73 J	1.21	3.1
	2/16/2016	**293**	**2170**	**119**	**3640**	880	22.1	7130.25	ND	0.84	0.42 J	0.71 J	4.18
	3/22/2016	**226**	**17.1**	**20.7**	**3630**	574	0.79	4499.71	ND	0.84	ND	2.00	28.28
	4/18/2016	**328**	0.53 J	**159**	**2030**	616	ND	3181.95	0.92 J	1.34	ND	ND	46.16
	5/16/2016	**437**	**2840**	**1330**	**7010**	1360	13.3	13010.42	0.54 J	1.18	0.68 J	1.33	16.39
	6/27/2016	**425**	**3550**	**2350**	**6440**	1560	25.6	14360.63	0.53 J	1.25	0.51 J	1.31	6.43
	8/30/2016	**346**	**2470**	**633**	**2990**	1940	6.80	8394.71	ND	1.32	0.48 J	1.31	5.8 J
P-2	12/16/2015	**491**	**2240**	**89.9**	**690**	869	13.1	4400.60	1.06	1.27	ND	1.30	3.97
	2/16/2016	**253**	**1760**	**25.9**	**2830**	708	17.3	5598.91	0.47 J	0.83	0.44 J	0.60 J	2.37
	3/14/2016	**105**	**213**	**14.3**	**1830**	213	6.16	2473.22	0.83 J	0.46 J	ND	7.05	83.42
	3/22/2016	**114**	**213**	**13.4**	**1890**	274	5.79	2575.06	0.76 J	ND	ND	3.24	60.87
	4/18/2016	**208**	**209**	**21.4**	**7480**	520	6.29	8478.32	ND	0.59	ND	1.04	32
	5/16/2016	**249**	**372**	**293**	**3740**	792	7.47	5481.25	0.88 J	0.64	0.45 J	0.94 J	24.87
	6/27/2016	**239**	**1250**	**322**	**2720**	707	22.9	5274.52	0.81 J	0.56	ND	0.70 J	11.55
	8/30/2016	**368**	**3040**	**2120**	**5810**	1580	18.4	12946.85	0.66 J	1.33	0.48 J	1.39	6.59 J
P-3	12/16/2015	**493**	**2390**	**101**	**656**	1020	13.5	4681.85	1.03	1.21	0.54 J	1.30	4.27
	2/16/2016	**305**	**1710**	**31.8**	**1380**	763	20.2	4215.84	1.15	0.83	ND	0.70 J	3.16
	3/14/2016	**76.7**	**215**	**7.42**	**786**	172	5.09	1350.37	0.45 J	ND	ND	2.93	84.78
	3/22/2016	**57.3**	**135**	**7.11**	**928**	141	3.24	1350.65	ND	ND	ND	2.34	76.66
	4/18/2016	**159**	**198**	**13.6**	**3460**	403	7.18	4283.22	1.11	ND	ND	1.07	40.26
	5/16/2016	**195**	**306**	**68.2**	**2170**	576	11.3	3359.03	1.00	0.47 J	ND	1.11	29.95
	6/27/2016	**182**	**932**	**98.6**	**1240**	516	23.8	3007.44	0.94 J	0.46 J	ND	0.54 J	13.1
	8/30/2016	**262**	**1420**	**1140**	**2790**	923	17.1	6557.75	0.63 J	0.77	ND	0.83 J	3.42 J
On-Site Monitoring Wells													
MW-1	11/12/2015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/15/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/14/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/27/2018	ND	1.30	ND	ND	ND	ND	1.30	ND	ND	ND	ND	ND
MW-2	11/10/2015	0.71 J	**55.3**	ND	60.7	ND	ND	116.71	ND	ND	ND	ND	ND
	11/17/2016	0.86 J	**85.4**	ND	159	ND	ND	245.26	ND	ND	ND	ND	ND
	11/14/2017	2.02	**117**	ND	**772**	ND	ND	891.83	ND	0.47 J	ND	0.34 J	ND
	11/27/2018	**309**	**544**	**46.1**	99.1	1020	1370	3399.62	2.62	ND	ND	ND	8.8 J
MW-3	11/10/2015	0.60 J	**47.1**	ND	13.3	ND	ND	61.00	ND	ND	ND	ND	ND
	2/16/2016	0.78 J	**40.4**	ND	7.38	ND	ND	48.56	ND	ND	ND	ND	ND
	5/17/2016	1.07	**53.7**	ND	23.1	2.15	ND	80.02	ND	ND	ND	ND	ND
	8/31/2016	0.63 J	**32.0**	ND	5.44	ND	ND	38.07	ND	ND	ND	ND	ND
	11/16/2016	0.62 J	**16.5**	ND	3.10	ND	ND	20.64	ND	ND	0.42 J	ND	ND
	2/20/2017	0.76 J	**18.0**	ND	2.35	2.90	ND	24.99	ND	0.44 J	0.54 J	ND	ND
	5/8/2017	1.50	**27.2**	ND	7.54	3.98	ND	40.82	ND	0.60	ND	ND	ND
	8/14/2017	1.70	**22.6**	ND	11.8	3.01	ND	41.14	ND	0.43 J	ND	ND	1.60 J
	11/14/2017	1.30	**24.6**	ND	24.4	6.70	ND	57.84	ND	0.84	ND	ND	ND
	2/19/2018	**4.07**	**102**	ND	116	11.9	ND	236.85	ND	2.88	ND	ND	ND
	5/21/2018	2.99	**78.3**	**6.13**	113	9.69	ND	221.81	ND	11.7	ND	ND	ND
	8/22/2018	1.52	**61.6**	ND	126	8.27	ND	210.35	ND	12.5	0.46 J	ND	ND
	11/27/2018	1.94	**77.1**	ND	167	11.6	ND	265.12	ND	7.48	ND	ND	ND
	2/18/2019	1.33	**38.4**	ND	88.4	7.17	ND	137.08	ND	1.78	ND	ND	ND
	5/13/2019	1.00	**30.6**	ND	50.8	ND	ND	82.92	ND	0.52	ND	ND	ND
MW-4	11/12/2015	**4.28**	**67.3**	ND	115	ND	ND	188.43	ND	1.85	ND	ND	ND
	11/15/2016	**10.6**	**105**	ND	58.2	ND	ND	174.84	ND	0.52	0.52 J	ND	ND
	11/14/2017	3.78	**49.3**	ND	41.3	ND	ND	96.66	ND	2.28	ND	ND	ND
	11/27/2018	**9.67**	**60.5**	ND	53.2	ND	ND	127.12	ND	3.75	ND	ND	ND
MW-5	11/10/2015	**6.51**	**155**	ND	**354**	ND	ND	515.51	ND	ND	ND	ND	ND
	11/15/2016	**5.66**	**149**	ND	**997**	ND	0.43 J	1152.09	ND	ND	ND	ND	ND
	11/14/2017	**43.6**	**318**	ND	**1240**	102	1.37	1704.97	ND	ND	ND	ND	ND
	11/27/2018	**13.5**	**335**	3.27 J	**2800**	46.9 J	2.82	3202.11	ND	ND	0.62 J	ND	ND

Table 2
Former AT&T Richmond Works Facility
Surface Water and Groundwater Monitoring Results, ug/l
Baseline Data for Shutdown begins in January 2016

Location	Date Sampled	1,1-DCA	1,1-DCE	MEC	1,1,1-TCA	1,4-Dioxane	Vinyl Chloride	TOTAL VOCs	Chloro-ethane	Chloroform	PCE	TCE	Other VOCs
Clean-up Goal, µg/l	mm/dd/yyyy	4	7	5	200	NA	NA	--	NA	NA	NA	NA	NA
	11/10/2015	**73.1**	**858**	ND	**2290**	270	4.70	3496.48	ND	ND	ND	0.68 J	ND
	2/16/2016	**29.6**	**621**	ND	**1810**	58.3 J	1.35	2520.25	ND	ND	ND	ND	ND
	5/17/2016	**122**	**1360**	2.06 J	**2510**	ND	14.3	4009.99	0.58 J	0.44 J	ND	0.61 J	ND
	8/30/2016	**150**	**1080**	ND	**1330**	365	68.5	2995.94	0.48 J	0.42 J	ND	0.48 J	1.06 J
	11/16/2016	**242**	**1440**	**7.13**	**1240**	777	97.4	3806.34	ND	0.44 J	ND	0.58 J	1.79 J
	2/20/2017	**227**	**1570**	**14.2**	**1460**	614	105	3993.50	0.73 J	0.42 J	ND	0.50 J	1.65
	5/8/2017	**255**	**1860**	**21.7**	**1610**	544	124	4418.96	1.38	0.42 J	ND	0.44 J	2.02
MW-6	8/14/2017	**479**	**2200**	**205**	**1050**	1190	695	5835.71	7.27	0.53	ND	0.82 J	8.09 J
	11/14/2017	**387**	**1380**	**98.0**	**860**	1290	1350	5391.80	20.3	ND	ND	0.39 J	6.11
	2/19/2018	**320**	**1050**	**86.2**	**1780**	845	843	4937.26	6.22	ND	ND	0.49 J	6.35 J
	5/21/2018	**883**	**1270**	**83.0**	**1260**	1110	1660	6289.92	17.4	0.56	0.57 J	0.40 J	4.99 J
	8/21/2018	**233**	**948**	**31.5**	**729**	582	1210	3742.84	4.01	ND	0.52 J	ND	4.81
	11/27/2018	**92.8**	**462**	**156**	**593**	200	84.8	1589.61	ND	ND	ND	ND	1.01
	2/18/2019	**11.1**	**165**	ND	**392**	ND	14.3	582.40	ND	ND	ND	ND	ND
	5/14/2019	**9.42**	**200**	ND	**539**	ND	10.4	758.82	ND	ND	ND	ND	ND
	11/12/2015	**181**	**1940**	**1070**	**6740**	834	3.64	10774.33	ND	0.79	0.51 J	1.13	3.26
	5/17/2016	**257**	**2850**	**1280**	**6560**	ND	19.9	10974.74	0.62 J	1.24	1.05	1.83	3.10
	11/15/2016	**333**	**2000**	**2070**	**3490**	1510	4.05	9429.80	0.58 J	1.48	0.64 J	1.50	18.55 J
	2/20/2017	**6.29**	**136**	ND	**457**	ND	ND	600.50	ND	0.60	0.61 J	ND	ND
	5/9/2017	**300**	**2700**	**10.9**	**1530**	883	1.51	5428.14	ND	0.94	0.58 J	1.21	ND
	8/14/2017	**236**	**2260**	ND	**1580**	573	1.87	4665.41	ND	1.10	0.91 J	1.31	11.22 J
MW-7	11/14/2017	**520**	**4740**	**16.2**	**1380**	771	2.3	7435.98	ND	1.63	1.65	2.53	2.97
	2/21/2018	**584**	**4990**	**14.3**	**1740**	960	3.48	8301.78	ND	2.21	1.52	2.45	3.82 J
	5/22/2018	**614**	**3980**	2.30 J	**1090**	562	3.25	6257.30	ND	2.75	1.14	1.86	ND
	8/21/2018	**377**	**4220**	**5.18**	**1380**	513	2.77	6504.90	ND	2.25	1.43	2.19	1.08 J
	11/27/2018	**651**	**2830**	ND	**393**	463	2.16	4344.33	1.06	1.16	0.82 J	1.55	0.58 J
	2/18/2019	**776**	**2120**	**29.9**	**814**	389	42.7	4247.02	70.6	1.18	1.11	1.51	1.02
	5/13/2019	**2710**	**2500**	**184**	**946**	836	396	7718.80	140	0.78	0.80 J	1.24	3.98 J
	11/12/2015	**110**	**886**	ND	**571**	299	0.71	1870.02	0.66 J	0.99	1.01	0.65 J	ND
	5/17/2016	**165**	**984**	1.47 J	**463**	ND	1.21	1618.02	ND	1.37	1.14	0.83 J	ND
	11/15/2016	**207**	**1210**	1.61 J	**476**	479	0.92	2379.10	0.71 J	1.74	1.16	0.96 J	ND
MW-8	5/8/2017	**161**	**711**	3.15 J	**342**	215	1.44	1437.89	1.09	1.12	1.12	0.97 J	ND
	11/14/2017	**68.8**	**554**	ND	174	102	0.82	901.86	0.42 J	0.73	0.65 J	0.44 J	ND
	5/21/2018	**42.9**	**326**	1.04 J	174	55.8 J	1.18	602.35	ND	1.43	ND	ND	ND
	11/27/2018	**38.9**	**326**	ND	95.5	107	1.35	570.38	ND	1.63	ND	ND	ND
	5/13/2019	**76.6**	**401**	1.11 J	185	ND	1.51	666.77	ND	1.55	ND	ND	ND
	11/12/2015	3.77	**17.9**	ND	6.66	3.01	ND	31.34	ND	ND	ND	ND	ND
	5/16/2016	3.76	5.85	ND	5.71	2.18	ND	17.50	ND	ND	ND	ND	ND
	11/15/2016	1.67	2.15	ND	5.76	ND	ND	9.58	ND	ND	ND	ND	ND
	5/8/2017	2.83	3.55	ND	6.81	ND	ND	13.19	ND	ND	ND	ND	ND
MW-9	11/16/2017	2.08	2.32	ND	8.88	ND	ND	13.28	ND	ND	ND	ND	ND
	5/22/2018	2.62	3.52	ND	7.53	ND	ND	13.67	ND	ND	ND	ND	ND
	11/26/2018	2.10	1.95	ND	8.87	ND	ND	20.21	ND	ND	ND	ND	7.29 J
	2/19/2019	1.82	1.89	ND	4.56	ND	ND	8.27	ND	ND	ND	ND	ND
	5/13/2019	1.76	2.52	ND	4.63	ND	ND	8.91	ND	ND	ND	ND	ND

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Location	Date Sampled	1,1-DCA	1,1-DCE	MEC	1,1,1-TCA	1,4-Dioxane	Vinyl Chloride	TOTAL VOCs	Chloro-ethane	Chloroform	PCE	TCE	Other VOCs
Clean-up Goal, µg/l	mm/dd/yyyy	4	7	5	200	NA	NA	--	NA	NA	NA	NA	NA
MW-10	11/10/2015	26.8	127	ND	116	ND	0.79	270.59	ND	ND	ND	ND	ND
	1/12/2016	796	3260	45.7	5370	1470	4.93	10952.08	1.37	0.84	ND	0.88 J	2.4
	2/16/2016	10.9	33.3	ND	82.8	ND	ND	134.27	ND	ND	ND	ND	7.27 J
	3/22/2016	515	372	65.1	4290	820	1.87	6238.91	0.99 J	0.50 J	ND	11.2	162.25
	4/18/2016	285	157	20.2	2380	324	2.28	3215.72	ND	ND	ND	1.56	45.68
	5/16/2016	217	0.54 J	58.5	1250	277	0.62	1841.93	0.61 J	ND	ND	1.4	36.26
	6/27/2016	184	230	61.9	1250	242	1.00	1992.72	ND	ND	ND	0.62 J	23.20
	8/30/2016	274	96.8	8.69	1500	425	1.37	2330.94	ND	0.56	ND	0.45 J	24.07 J
	11/16/2016	144	625	1.26 J	399	346	16.7	1533.16	ND	0.41 J	ND	0.39 J	0.40 J
	2/20/2017	224	931	4.69	278	568	66.3	2074.58	ND	0.52	ND	0.56 J	1.51
	5/9/2017	172	927	3.14 J	267	353	57.8	1780.92	ND	ND	ND	0.41 J	0.57 J
	8/14/2017	129	766	9.48	219	333	132	1596.69	1.44	ND	ND	0.34 J	6.43 J
	11/14/2017	106	252	29.3	139	238	126	898.54	0.64 J	ND	ND	ND	7.60
	2/20/2018	120	681	82.0	945	296	87.6	2212.79	0.73 J	ND	ND	ND	0.46 J
	5/22/2018	253	1560	38.8	2690	560	56.8	5162.11	ND	0.85	0.41 J	0.83 J	1.42 J
	8/21/2018	201	1030	68.0	1490	339	90.7	3222.07	2.48	ND	ND	0.48 J	0.41 J
	11/28/2018	195	772	19.2	812	379	79.4	2259.04	1.01	ND	ND	0.53 J	0.90 J
	2/18/2019	1250	1870	26.5	1040	781	358	5339.38	3.25	0.64	0.76 J	1.22	8.01 J
	5/13/2019	609	1030	17.6	477	553	351	3048.41	3.59	ND	0.52 J	0.68 J	6.02 J
MW-11	11/12/2015	14.9	102	ND	74.3	20.1	ND	211.79	ND	0.49 J	ND	ND	ND
	2/16/2016	14.3	108	ND	94.8	14.4	ND	232.12	ND	0.62	ND	ND	ND
	5/17/2016	13.2	113	1.26 J	90.7	18.0	ND	236.75	ND	0.59	ND	ND	ND
	8/30/2016	13.4	150	ND	114	15.8	ND	293.91	ND	0.71	ND	ND	ND
	11/16/2016	11.7	123	ND	102	15.1	ND	253.66	ND	0.82	ND	ND	1.04 J
	2/20/2017	10.2	113	ND	109	12.8	ND	245.76	ND	0.76	ND	ND	ND
	5/9/2017	10.8	166	ND	144	11.3	ND	332.52	ND	ND	ND	0.42 J	ND
	8/14/2017	12.2	135	ND	129	12.3	ND	290.19	ND	0.50 J	ND	ND	1.19 J
	11/14/2017	7.74	84.8	ND	93.1	10.1	ND	196.16	ND	0.42 J	ND	ND	ND
	2/20/2018	11.5	112	ND	96.4	7.05	ND	227.40	ND	0.45 J	ND	ND	ND
	5/22/2018	14.2	116	4.74	86.8	7.09	ND	229.93	ND	0.69	0.41 J	ND	ND
	8/21/2018	11.4	90.7	ND	67.6	10.8	ND	181.16	ND	0.66	ND	ND	ND
	11/28/2018	9.77	129	ND	68.3	13.1	ND	220.92	ND	0.75	ND	ND	ND
	2/18/2019	12.3	129	ND	76.1	17.8	ND	236.59	ND	0.99	0.40 J	ND	ND
	5/14/2019	10.2	139	ND	79.8	11.1	ND	240.93	ND	0.83	ND	ND	ND
MW-12	11/10/2015	43.3	974	ND	876	124	ND	2019.22	ND	0.61	0.50 J	0.81 J	ND
	11/16/2016	49.5	364	8.72	537	70.7 J	0.36 J	1039.53	ND	0.64	0.50 J	0.51 J	7.6 J
	11/14/2017	55.4	1380	6.16	1310	ND	1.61	2792.72	ND	0.89	0.59 J	0.92 J	37.15
	11/27/2018	34.7	250	19.8	841	ND	1.07	1177.98	ND	0.88	ND	ND	30.53 J
MW-13	11/10/2015	15.4	122	ND	9.31	ND	ND	147.15	ND	ND	ND	ND	0.44 J
	5/17/2016	19.4	161	ND	10.5	ND	ND	191.30	ND	ND	ND	ND	0.40 J
	11/16/2016	18.7	166	ND	12.6	ND	ND	197.62	ND	ND	ND	ND	0.32 J
	5/9/2017	19.0	157	ND	10.9	ND	ND	187.68	ND	0.49 J	ND	ND	0.29 J
	11/14/2017	16.2	143	ND	8.59	ND	ND	168.14	ND	ND	ND	ND	0.35 J
	5/22/2018	19.8	152	5.76	10.4	ND	ND	189.63	ND	0.55	ND	ND	1.12
	11/28/2018	17.7	176	ND	10.2	ND	ND	203.90	ND	ND	ND	ND	ND
	5/14/2019	15.8	153	1.43 J	8.16	ND	ND	178.39	ND	ND	ND	ND	ND

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Location	Date Sampled	1,1-DCA	1,1-DCE	MEC	1,1,1-TCA	1,4-Dioxane	Vinyl Chloride	TOTAL VOCs	Chloro-ethane	Chloroform	PCE	TCE	Other VOCs
Clean-up Goal, µg/l	mm/dd/yyyy	4	7	5	200	NA	NA	--	NA	NA	NA	NA	NA
MW-14R	11/12/2015	0.60 J	**9.35**	ND	1.08	ND	ND	11.77	ND	ND	ND	ND	0.74 J
	2/16/2016	0.87 J	**12.5**	ND	2.15	ND	ND	16.36	ND	ND	ND	ND	0.84 J
	5/16/2016	0.88 J	**9.63**	ND	2.26	ND	ND	13.41	ND	ND	ND	ND	0.64 J
	8/31/2016	1.31	**13.3**	ND	3.78	ND	ND	19.07	ND	ND	ND	ND	0.68 J
	11/16/2016	1.13	**8.36**	ND	2.89	ND	ND	13.00	ND	ND	ND	ND	0.62 J
	2/22/2017	1.54	**11.9**	ND	3.72	ND	ND	17.57	ND	ND	ND	ND	0.41 J
	5/8/2017	1.43	**8.98**	ND	3.28	ND	ND	14.02	ND	ND	ND	ND	0.33 J
	8/16/2017	1.47	**8.92**	ND	3.38	ND	ND	15.68	ND	ND	ND	ND	1.91 J
	11/16/2017	1.56	**10.3**	ND	3.42	ND	ND	15.61	ND	ND	ND	ND	0.33 J
	2/20/2018	2.24	**11.9**	ND	4.18	ND	ND	18.63	ND	ND	ND	ND	0.31 J
	5/22/2018	2.08	**11.6**	ND	4.05	ND	ND	17.73	ND	ND	ND	ND	ND
	8/21/2018	1.92	**7.44**	ND	4.20	ND	ND	13.56	ND	ND	ND	ND	ND
	11/26/2018	2.08	**9.84**	ND	4.85	ND	ND	16.77	ND	ND	ND	ND	ND
	2/18/2019	2.54	**9.27**	ND	5.75	ND	ND	17.56	ND	ND	ND	ND	ND
	5/13/2019	2.75	**12.0**	ND	7.26	ND	ND	22.01	ND	ND	ND	ND	ND
MW-15R	11/12/2015	**4.94**	**24.9**	ND	7.64	ND	0.72	38.20	ND	ND	ND	ND	ND
	5/17/2016	**8.54**	**39.0**	2.13 J	7.95	ND	2.25	59.87	ND	ND	ND	ND	ND
	11/15/2016	**12.3**	**38.9**	ND	20.8	ND	2.74	74.74	ND	ND	ND	ND	ND
	5/8/2017	**4.35**	**9.86**	ND	ND	ND	1.31	15.52	ND	ND	ND	ND	ND
	11/14/2017	**5.15**	**20.3**	ND	1.65	ND	1.56	28.66	ND	ND	ND	ND	ND
	5/24/2018	**4.66**	**11.8**	**8.98**	1.71	ND	1.52	28.67	ND	ND	ND	ND	ND
	11/27/2018	2.89	**12.8**	ND	3.22	ND	1.03	19.94	ND	ND	ND	ND	ND
	5/14/2019	**8.46**	**27.3**	ND	3.72	ND	1.87	41.35	ND	ND	ND	ND	ND
MW-16	11/12/2015	**173**	**67.5**	**6.63**	ND	141	65.8	485.21	11.5	ND	ND	ND	19.78
	1/12/2016	**146**	**35.1**	**6.93**	2.00	ND	17.6	239.95	8.54	ND	ND	ND	23.78
	2/18/2016	**115**	**41.3**	**6.01**	ND	59.9 J	23.5	272.65	5.77	ND	ND	ND	21.17
	3/22/2016	**133**	**88.3**	4.30	ND	ND	54.3	303.41	8.51	ND	ND	ND	15.00
	4/18/2016	**136**	**130**	**6.08**	7.75	103	73.7	488.19	6.12	ND	ND	ND	25.54
	5/16/2016	**188**	**322**	**5.77**	ND	184	134	860.93	ND	ND	ND	ND	27.16
	6/27/2016	**163**	**122**	**6.59**	0.83 J	160	151	637.28	9.51	ND	ND	ND	24.35
	8/30/2016	**155**	**53.6**	3.00 J	4.43	109	66.4	415.92	9.02	ND	ND	ND	15.47 J
	11/18/2016	**117**	**21.1**	4.58	ND	51.9 J	19.8	239.63	ND	ND	ND	ND	23.75 J
	2/22/2017	**118**	**23.2**	**6.37**	3.63	87.9 J	39.9	313.88	3.32	ND	ND	ND	31.56
	5/9/2017	**129**	**78.8**	**7.18**	21.1	82.9	54.2	408.36	ND	ND	ND	ND	35.18
	8/14/2017	**78.6**	**50.1**	3.76 J	7.98	54.9 J	33.0	260.13	4.84	ND	ND	ND	26.95 J
	11/16/2017	**94.9**	**108**	3.93 J	3.15	57.8 J	40.3	336.99	ND	ND	ND	ND	28.91
	2/21/2018	**167**	**254**	**8.93**	8.61	80.8 J	55.1	611.61	12.2	ND	ND	ND	24.97 J
	5/21/2018	**97.6**	**98.0**	**5.08**	2.25	56.3 J	59.8	331.66	ND	ND	ND	ND	12.63 J
	8/21/2018	**127**	**40.6**	2.76 J	ND	ND	ND	241.12	43.8	ND	ND	ND	26.96 J
	11/27/2018	**98.1**	**42.6**	2.81 J	ND	ND	8.62	203.82	27.5	ND	ND	ND	24.19 J
	2/18/2019	**109**	**36.6**	2.21 J	ND	ND	6.44	193.78	22.3	ND	ND	ND	17.23 J
	5/13/2019	**83.0**	**38.2**	2.33 J	ND	ND	7.70	152.66	8.17	ND	ND	ND	13.26 J

Table 2
Former AT&T Richmond Works Facility
Surface Water and Groundwater Monitoring Results, ug/l
Baseline Data for Shutdown begins in January 2016

Location	Date Sampled	1,1-DCA	1,1-DCE	MEC	1,1,1-TCA	1,4-Dioxane	Vinyl Chloride	TOTAL VOCs	Chloro-ethane	Chloroform	PCE	TCE	Other VOCs
Clean-up Goal, µg/l	mm/dd/yyyy	4	7	5	200	NA	NA	--	NA	NA	NA	NA	NA
MW-17	11/12/2015	**34.5**	**35.5**	ND	17.7	14.9	3.91	106.51	ND	ND	ND	ND	ND
	1/12/2016	**210**	**260**	ND	146	94.3	27.1	742.43	3.25	ND	ND	0.31 J	1.47
	2/18/2016	**179**	**138**	ND	90.3	75.0	11.7	496.14	2.14	ND	ND	ND	ND
	3/22/2016	**123**	**89.8**	ND	50.9	93.1	10.7	368.66	1.16	ND	ND	ND	ND
	4/18/2016	**238**	**303**	2.04 J	163	125.0	36.4	871.90	3.26	ND	ND	0.36 J	0.84
	5/16/2016	**134**	**132**	2.16 J	51.8	96.4	18.9	437.93	1.96	ND	ND	ND	0.71
	6/27/2016	**122**	**139**	1.43 J	47.0	59.5	24.4	395.77	1.91	ND	ND	ND	0.53
	8/31/2016	**121**	**148**	ND	43.8	93.1	29.9	438.36	1.77	ND	ND	ND	0.79 J
	11/18/2016	**142**	**130**	ND	38.4	82.5	23.2	422.09	ND	ND	ND	ND	5.99 J
	2/22/2017	**130**	**121**	ND	37.7	87.9	21.9	400.53	ND	ND	ND	ND	2.03
	5/9/2017	**114**	**100**	ND	31.2	95.7	19.5	374.47	ND	ND	ND	ND	14.07
	8/16/2017	**161**	**168**	ND	60.6	126.0	43.7	576.11	1.79	ND	ND	ND	15.02 J
	11/16/2017	**194**	**229**	ND	84.0	82.6 J	44.4	653.85	2.53	ND	ND	ND	17.32
	2/21/2018	**171**	**174**	ND	58.7	78.3	29.8	523.75	1.62	ND	ND	ND	10.33 J
	5/22/2018	**30.0**	**32.2**	1.00 J	11.1	17.1	4.02	103.05	ND	ND	ND	ND	7.63 J
	8/21/2018	**89.6**	**61.2**	ND	13.1	59.0	20.2	270.49	ND	ND	ND	ND	27.39 J
	11/26/2018	**91.0**	**101**	ND	22.9	67.3	27.7	324.95	ND	ND	ND	ND	15.05 J
	2/19/2019	**67.0**	**53.9**	ND	14.6	26.2	5.38	189.08	0.71 J	ND	ND	ND	21.29 J
	5/13/2019	**133**	**154**	ND	45.2	70.0	17.0	462.63	ND	ND	ND	ND	43.43 J
MW-18	11/10/2015	**109**	**702**	ND	107	162	40.8	1136.14	9.00	1.18	0.80 J	0.93 J	3.43
	11/18/2016	**137**	**936**	3.25 J	**220**	214	7.97	1526.24	2.04	1.37	1.08	0.95 J	2.58 J
	11/16/2017	**99.2**	**584**	3.27 J	70.1	135	26.5	935.00	3.81	1.18	0.82 J	0.79 J	10.33
	11/26/2018	**77.9**	**441**	2.58 J	70.0	110	12.3	727.71	1.60	0.91	0.84 J	0.57 J	10.01 J
MW-21R	11/12/2015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/15/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/16/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/26/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-22R	11/12/2015	0.95 J	0.58 J	ND	11.2	ND	ND	12.73	ND	ND	ND	ND	ND
	5/16/2016	0.62 J	0.32 J	2.05 J	3.03	ND	ND	6.02	ND	ND	ND	ND	ND
	6/28/2016	0.75 J	ND	1.07 J	3.94	ND	ND	5.76	ND	ND	ND	ND	ND
	11/18/2016	2.02	1.2	ND	22.7	ND	ND	25.92	ND	ND	ND	ND	ND
	5/8/2017	0.73 J	ND	ND	3.27	ND	ND	4.00	ND	ND	ND	ND	ND
	11/16/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/22/2018	ND	ND	ND	0.63 J	ND	ND	0.63	ND	ND	ND	ND	ND
	11/26/2018	ND	ND	ND	0.90 J	ND	ND	1.92	ND	ND	ND	ND	1.02 J
	5/13/2019	0.90 J	ND	ND	3.82	ND	ND	4.72	ND	ND	ND	ND	ND
MW-23	11/12/2015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/16/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/16/2016	ND	ND	1.61 J	1.01	ND	ND	2.62	ND	ND	ND	ND	ND
	8/31/2016	ND	ND	ND	1.00 J	ND	ND	1.00	ND	ND	ND	ND	ND
	11/18/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/22/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/8/2017	ND	ND	ND	1.05	ND	ND	1.05	ND	ND	ND	ND	ND
	8/16/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/16/2017	ND	1.64	ND	ND	ND	ND	1.64	ND	ND	ND	ND	ND
	2/19/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/22/2018	0.89 J	**11.8**	ND	2.07	ND	ND	14.76	ND	ND	ND	ND	ND
	8/21/2018	ND	0.79 J	ND	2.06	ND	ND	2.85	ND	ND	ND	ND	ND
	11/26/2018	1.10	**16.5**	ND	1.93	ND	ND	19.53	ND	ND	ND	ND	ND
	2/18/2019	ND	ND	ND	1.54	ND	ND	1.54	ND	ND	ND	ND	ND
	5/13/2019	ND	0.83 J	ND	2.63	ND	ND	3.46	ND	ND	ND	ND	ND

Table 2
Former AT&T Richmond Works Facility
Surface Water and Groundwater Monitoring Results, ug/l
Baseline Data for Shutdown begins in January 2016

Location	Date Sampled	1,1-DCA	1,1-DCE	MEC	1,1,1-TCA	1,4-Dioxane	Vinyl Chloride	TOTAL VOCs	Chloro-ethane	Chloroform	PCE	TCE	Other VOCs
Clean-up Goal, µg/l	mm/dd/yyyy	4	7	5	200	NA	NA	--	NA	NA	NA	NA	NA
MW-24	11/12/2015	**18.1**	**162**	ND	21.5	104	ND	305.60	ND	ND	ND	ND	ND
	2/18/2016	**24.4**	**168**	ND	22.2	81.4 J	ND	296.55	ND	0.55	ND	ND	ND
	5/16/2016	**23.6**	**199**	ND	20.3	71.0 J	ND	313.90	ND	ND	ND	ND	ND
	8/31/2016	**23.3**	**178**	ND	17.1	127	ND	345.40	ND	ND	ND	ND	ND
	11/18/2016	**28.7**	**197**	ND	20.7	92.8 J	ND	339.20	ND	ND	ND	ND	ND
	2/22/2017	**24.2**	**158**	1.36 J	15.3	82.6 J	ND	281.46	ND	ND	ND	ND	ND
	5/8/2017	**27.8**	**178**	ND	16.9	54.7 J	ND	277.40	ND	ND	ND	ND	ND
	8/16/2017	**27.0**	**180**	ND	16.7	103	0.30 J	328.21	ND	ND	ND	ND	1.21 J
	11/16/2017	**30.8**	**214**	ND	17.4	121	ND	383.20	ND	ND	ND	ND	ND
	2/21/2018	**26.0**	**168**	ND	15.7	77.0	ND	286.70	ND	ND	ND	ND	ND
	5/22/2018	**27.7**	**149**	ND	17.8	115	ND	309.50	ND	ND	ND	ND	ND
	8/21/2018	**27.7**	**164**	ND	16.7	61.4 J	0.56	270.36	ND	ND	ND	ND	ND
	11/26/2018	**23.4**	**166**	ND	13.2	49.4 J	0.99	252.99	ND	ND	ND	ND	ND
	2/19/2019	**24.9**	**135**	ND	12.9	67.9 J	0.73	241.43	ND	ND	ND	ND	ND
	5/13/2019	**30.4**	**163**	ND	15.0	ND	1.02	209.42	ND	ND	ND	ND	ND
MW-25	11/12/2015	**8.54**	**84.8**	ND	14.5	25.9	ND	135.06	ND	0.85	0.47 J	ND	ND
	2/18/2016	**11.7**	**94.5**	ND	18.1	30.1	ND	155.81	ND	0.82	0.59 J	ND	ND
	5/16/2016	**12.4**	**136**	ND	24.2	40.5	ND	214.40	ND	0.71	0.62 J	ND	ND
	8/30/2016	**13.5**	**165**	ND	34.9	47.2	ND	262.16	ND	0.89	0.67 J	ND	ND
	11/15/2016	**12.5**	**140**	ND	39.8	48.7	ND	242.56	ND	0.87	0.69 J	ND	ND
	2/22/2017	**12.3**	**126**	ND	44.9	43.9	ND	228.54	ND	0.74	0.70 J	ND	ND
	5/8/2017	**13.1**	**140**	ND	61.2	40.0	ND	255.68	ND	0.77	0.61 J	ND	ND
	8/14/2017	**13.3**	**154**	ND	84.6	62.3	ND	317.09	ND	0.61	0.64 J	ND	1.64 J
	11/16/2017	**9.46**	**133**	ND	82.7	46.6	ND	272.80	ND	0.53	0.51 J	ND	ND
	2/21/2018	**15.4**	**209**	ND	141	48.7	ND	415.36	ND	0.71	0.55 J	ND	ND
	5/22/2018	**20.7**	**238**	**6.38**	156	64.5	ND	487.16	ND	1.01	0.57 J	ND	ND
	8/21/2018	**18.9**	**269**	ND	183	92.1	ND	564.37	ND	0.68	0.69 J	ND	ND
	11/27/2018	**17.5**	**350**	ND	198	101	ND	667.66	ND	0.61	0.55 J	ND	ND
	2/18/2019	**28.0**	**341**	ND	**237**	102	1.03	710.25	ND	0.65	0.57 J	ND	ND
	5/14/2019	**22.9**	**372**	ND	**261**	120	ND	777.12	ND	0.58	0.64	ND	ND
MW-26	11/12/2015	**11.7**	**157**	ND	103	70.3 J	ND	342.00	ND	ND	ND	ND	ND
	5/17/2016	**20.4**	**354**	ND	**376**	ND	ND	750.40	ND	ND	ND	ND	ND
	11/17/2016	**23.2**	**464**	ND	**1450**	105	ND	2042.20	ND	ND	ND	ND	ND
	5/9/2017	**15.6**	**247**	ND	**234**	78.9 J	ND	575.50	ND	ND	ND	ND	ND
	11/14/2017	**24.0**	**290**	ND	153	68.1 J	ND	535.10	ND	ND	ND	ND	ND
	5/22/2018	**40.9**	**445**	ND	**208**	137	1.41	832.31	ND	ND	ND	ND	ND
	11/27/2018	**8.59**	**115**	ND	24.8	ND	ND	148.39	ND	ND	ND	ND	ND
	5/14/2019	**6.29**	**74.4**	ND	37.1	ND	ND	117.79	ND	ND	ND	ND	ND
MW-28	11/12/2015	3.01	**48.8**	ND	114	5.83	ND	174.91	ND	3.27	ND	ND	ND
	1/12/2016	3.31	**91.5**	ND	**231**	11.4	ND	342.16	ND	4.95	ND	ND	ND
	2/16/2016	1.59	**44.9**	ND	104	5.96	ND	162.30	ND	5.85	ND	ND	ND
	3/22/2016	1.59	**41.5**	ND	71.2	12.4	ND	134.12	ND	7.43	ND	ND	ND
	4/18/2016	2.66	**32.5**	1.34 J	28.6	7.93	ND	81.92	ND	8.89	ND	ND	ND
	5/17/2016	2.58	**29.4**	1.18 J	23.4	7.52	ND	74.00	ND	9.52	ND	ND	ND
	6/27/2016	2.50	**29.2**	1.18 J	19.9	8.08	ND	70.57	ND	9.71	ND	ND	ND
	8/31/2016	2.70	**31.3**	ND	18.5	7.70	ND	70.90	ND	10.7	ND	ND	ND
	11/15/2016	3.22	**32.0**	ND	26.0	9.29	ND	80.81	ND	10.3	ND	ND	ND
	2/20/2017	3.06	**22.3**	ND	21.5	9.62	ND	65.83	ND	9.35	ND	ND	ND
	5/8/2017	2.68	**21.2**	ND	15.1	8.74	ND	58.84	ND	10.6	ND	ND	0.52 J
	8/16/2017	2.78	**18.5**	ND	9.72	7.84	ND	48.18	ND	8.07	ND	ND	1.27 J
	11/16/2017	**4.08**	**12.7**	ND	6.63	5.28	ND	35.22	ND	5.16	1.37	ND	ND
	2/19/2018	**6.51**	**9.91**	ND	7.52	3.23	ND	32.90	ND	3.56	2.17	ND	ND
	5/21/2018	**7.67**	**10.1**	ND	9.32	4.38	ND	37.34	ND	2.76	3.11	ND	ND
	8/22/2018	**7.82**	**7.03**	ND	9.54	3.19	ND	32.49	ND	1.32	3.59	ND	ND
	11/27/2018	**7.36**	**7.66**	ND	11.8	3.11	ND	33.73	ND	0.60	3.20	ND	ND
	2/18/2019	**7.57**	4.68	ND	11.3	4.84	ND	30.63	ND	ND	2.24	ND	ND
	5/13/2019	**9.06**	5.99	ND	20.3	4.42	ND	50.95	ND	ND	1.42	ND	9.76 J

Table 2
Former AT&T Richmond Works Facility
Surface Water and Groundwater Monitoring Results, ug/l
Baseline Data for Shutdown begins in January 2016

Location	Date Sampled	1,1-DCA	1,1-DCE	MEC	1,1,1-TCA	1,4-Dioxane	Vinyl Chloride	TOTAL VOCs	Chloro-ethane	Chloroform	PCE	TCE	Other VOCs
Clean-up Goal, µg/l	mm/dd/yyyy	4	7	5	200	NA	NA	--	NA	NA	NA	NA	NA
MW-29	11/10/2015	**6.44**	**14.2**	ND	18.2	ND	ND	38.84	ND	ND	ND	ND	ND
	11/15/2016	**6.83**	**7.03**	ND	11.2	ND	ND	25.69	ND	ND	ND	ND	0.63 J
	11/16/2017	**5.14**	6.96	ND	5.84	ND	ND	18.64	ND	ND	ND	ND	0.70 J
	11/26/2018	3.49	4.51	ND	6.51	ND	ND	14.51	ND	ND	ND	ND	ND
MW-30R	11/12/2015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/15/2016	0.67 J	ND	ND	ND	ND	ND	0.67	ND	ND	ND	ND	ND
	11/16/2017	0.48 J	ND	ND	ND	ND	ND	0.48	ND	ND	ND	ND	ND
	11/26/2018	ND	ND	ND	1.85	ND	ND	1.85	ND	ND	ND	ND	ND
MW-33	11/12/2015	**98.8**	**2320**	ND	**6620**	666	0.44 J	9710.25	ND	0.94	0.84 J	1.45	1.78
	2/18/2016	**132**	**2300**	1.66 J	**5300**	606	0.40 J	8344.41	ND	0.99	0.73 J	1.31	1.32
	3/22/2016	**176**	**2380**	1.28 J	**4880**	837	0.98	8279.92	ND	0.99	0.88 J	1.38	1.41
	4/18/2016	**170**	**2800**	3.02 J	**4110**	448	1.18	7537.85	ND	0.96	0.83 J	1.53	2.33
	5/18/2016	**266**	**3490**	1.99 J	**4200**	568	1.87	8533.00	ND	1.03	0.79 J	1.57	1.34
	6/27/2016	**253**	**3110**	3.27 J	**3190**	544	2.14	7106.88	ND	1.03	0.77 J	1.46	1.18
	8/30/2016	**288**	**1000**	ND	**1100**	569	2.38	2963.42	ND	1.14	0.76 J	1.36	0.78 J
	11/15/2016	**327**	**1960**	4.29	**1500**	669	2.35	4468.62	ND	1.02	1.04	1.68	2.24 J
	2/20/2017	**274**	**2640**	**6.46**	**2760**	540	1.15	6226.10	ND	0.86	0.75 J	1.48	1.40
	5/9/2017	**335**	**2170**	**15.0**	**3080**	421	1.29	6058.42	0.69 J	1.26	0.78 J	2.16	31.24
	8/14/2017	**206**	**832**	**19.3**	**1740**	179	1.51	3075.39	0.53 J	1.07	ND	1.47	94.51 J
	11/16/2017	**247**	**129**	**45.1**	**2760**	219	1.34	3555.51	0.94 J	1.35	ND	1.44	150.34
	2/21/2018	**279**	**587**	**54.1**	**2400**	147	2.03	3618.97	0.63 J	1.56	0.58 J	1.93	145.14
	5/22/2018	**252**	**1690**	**29.5**	**3440**	203	3.10	5716.99	ND	1.75	1.00	2.58	94.06 J
	8/21/2018	**236**	**877**	**49.0**	**2930**	214	6.40	4415.05	ND	1.25	0.77 J	2.23	98.4 J
	11/27/2018	**274**	**213**	**77.4**	**1580**	276	4.38	2499.27	ND	0.94	0.51 J	1.33	71.71
	2/18/2019	**236**	**1240**	**54.0**	**2060**	254	19.4	3917.16	ND	0.95	0.87 J	2.03	49.91 J
	5/13/2019	**291**	**1200**	**87.6**	**2060**	469	25.8	4180.22	ND	0.82	0.70 J	1.87	43.43 J
MW-34	11/12/2015	**44.2**	**585**	ND	52.4	31.7	ND	724.56	ND	3.80	5.24	1.56	0.66
	3/22/2016	**55.9**	**878**	ND	69.8	29.1	ND	1044.15	ND	3.83	5.38	1.51	0.63
	4/18/2016	**46.4**	**593**	2.52 J	57.7	27.5	ND	735.46	ND	3.28	3.93	1.13	ND
	5/17/2016	**76.9**	**938**	ND	89.6	40.2	ND	1158.40	ND	4.42	7.18	2.10	ND
	6/27/2016	**57.4**	**952**	ND	62.6	37.5	ND	1118.92	ND	3.38	4.62	1.42	ND
	8/30/2016	**49.2**	**557**	ND	59.4	26.7	ND	701.16	ND	3.21	3.91	1.23	0.51 J
	11/15/2016	**37.7**	**571**	ND	43.3	23.8	ND	682.90	ND	2.32	3.75	1.03	ND
	2/20/2017	**36.4**	**483**	ND	36.9	19.2	ND	581.57	ND	2.13	2.95	0.99 J	ND
	5/9/2017	**53.4**	**692**	ND	49.7	24.9	ND	828.70	ND	2.67	4.57	1.46	ND
	8/15/2017	**77.3**	**803**	ND	72.4	24.5	ND	989.04	ND	4.52	4.28	1.85	1.19 J
	11/14/2017	**55.6**	**569**	ND	50.6	22.9	ND	705.74	ND	2.81	3.53	1.30	ND
	2/19/2018	**56.3**	**638**	ND	52.1	22.7	ND	776.49	ND	2.44	3.66	1.29	ND
	5/22/2018	**50.0**	**769**	ND	37.9	22.8	ND	886.26	ND	2.05	3.43	1.08	ND
	8/21/2018	**25.4**	**318**	ND	44.1	19.6	ND	411.16	ND	1.37	2.03	0.66	ND
	11/27/2018	**4.70**	**80.8**	ND	4.11	7.95	ND	98.11	ND	ND	0.55 J	ND	ND
	2/19/2019	**4.48**	**64.1**	ND	6.24	6.71	ND	82.01	ND	ND	0.48 J	ND	ND
	5/14/2019	3.36	**66.8**	ND	5.66	6.97	ND	83.28	ND	ND	0.49 J	ND	ND
MW-35	11/12/2015	**4.86**	**74.9**	ND	11.2	12.0	ND	105.54	ND	1.23	1.35	ND	ND
	5/16/2016	**12.4**	**184**	1.60 J	84.5	14.3	ND	300.80	ND	1.62	1.92	0.45 J	ND
	6/27/2016	**11.6**	**185**	1.79 J	86.1	11.5	ND	299.70	ND	1.45	1.82	0.44 J	ND
	7/20/2016	**12.8**	**196**	1.88 J	116	15.6	ND	347.31	ND	1.60	2.82	0.61 J	ND
	8/30/2016	**14.0**	**241**	ND	153	14.4	ND	426.25	ND	1.45	1.94	0.49 J	ND
	11/15/2016	**14.2**	**239**	ND	184	10.7	ND	451.73	ND	1.47	1.85	0.51 J	ND
	2/22/2017	**13.2**	**178**	ND	177	14.4	ND	385.92	ND	1.37	1.51	0.44 J	ND
	5/8/2017	**16.4**	**277**	ND	181	14.0	ND	492.75	ND	1.52	2.16	0.67 J	ND
	8/14/2017	**16.4**	**255**	ND	**218**	20.4	ND	513.81	ND	1.18	1.76	0.57 J	0.50 J
	11/14/2017	**11.2**	**222**	ND	194	15.3	ND	445.56	ND	1.01	1.65	0.40 J	ND
	2/21/2018	**11.7**	**202**	ND	162	13.4	ND	391.49	ND	0.94	1.12	0.33 J	ND
	5/22/2018	**14.5**	**247**	ND	**222**	18.7	ND	505.07	ND	1.20	1.16	0.51 J	ND
	8/21/2018	**10.1**	**182**	ND	173	10.5	ND	377.51	ND	0.81	1.10	ND	ND
	11/27/2018	**8.80**	**225**	ND	175	14.2	ND	425.00	ND	0.78	1.22	ND	ND
	2/18/2019	**11.2**	**205**	ND	197	16.6	ND	431.80	ND	0.74	1.26	ND	ND
	5/14/2019	**14.1**	**272**	ND	**351**	19.6	ND	658.88	ND	1.01	1.17	ND	ND

Table 2
Former AT&T Richmond Works Facility
Surface Water and Groundwater Monitoring Results, ug/l
Baseline Data for Shutdown begins in January 2016

Location	Date Sampled	1,1-DCA	1,1-DCE	MEC	1,1,1-TCA	1,4-Dioxane	Vinyl Chloride	TOTAL VOCs	Chloro-ethane	Chloroform	PCE	TCE	Other VOCs
Clean-up Goal, µg/l	**mm/dd/yyyy**	**4**	**7**	**5**	**200**	**NA**	**NA**	**--**	**NA**	**NA**	**NA**	**NA**	**NA**
MW-36	11/12/2015	**13.8**	**173**	ND	33.0	84.9 J	ND	305.31	ND	0.61	ND	ND	ND
	2/16/2016	**16.0**	**192**	ND	40.7	48.4 J	ND	297.79	ND	0.69	ND	ND	ND
	5/16/2016	**13.5**	**156**	2.02 J	37.5	ND	ND	209.50	ND	0.50 J	ND	ND	ND
	6/27/2016	**10.8**	**132**	1.96 J	41.2	42.2	ND	228.16	ND	ND	ND	ND	ND
	7/20/2016	**13.0**	**148**	1.65 J	57.3	44.9	ND	266.64	ND	0.79	0.66 J	0.34 J	ND
	8/30/2016	**15.5**	**190**	ND	63.2	66.7	ND	335.90	ND	0.50 J	ND	ND	ND
	11/15/2016	**15.2**	**174**	ND	56.3	69.5	ND	315.41	ND	0.41 J	ND	ND	0.41 J
	2/22/2017	**11.1**	**108**	ND	48.6	44.1	ND	211.80	ND	ND	ND	ND	ND
	5/8/2017	**10.0**	**114**	ND	53.1	38.3	ND	215.98	ND	0.58	ND	ND	ND
	8/14/2017	**25.6**	**231**	ND	92.4	112	ND	462.34	ND	ND	ND	ND	1.34 J
	11/16/2017	**18.4**	**163**	ND	60.0	132	ND	373.40	ND	ND	ND	ND	ND
	2/21/2018	**22.4**	**174**	ND	65.2	93.4	ND	355.00	ND	ND	ND	ND	ND
	5/22/2018	**22.1**	**210**	1.28 J	90.9	91.7	0.65	424.50	ND	0.72	ND	ND	7.15 J
	8/21/2018	**28.8**	**313**	ND	148	115	1.42	606.22	ND	ND	ND	ND	ND
	11/27/2018	**10.5**	**138**	ND	67.6	50.1	ND	266.20	ND	ND	ND	ND	ND
	2/18/2019	**8.03**	**103**	ND	74.8	32.5	ND	218.33	ND	ND	ND	ND	ND
	5/14/2019	**6.28**	**110**	ND	98.1	29.8	ND	244.18	ND	ND	ND	ND	ND
MW-37	11/12/2015	3.42	**58.3**	ND	10.9	ND	ND	72.62	ND	ND	ND	ND	ND
	11/15/2016	**4.75**	**82.6**	ND	14.4	ND	ND	101.75	ND	ND	ND	ND	ND
	11/16/2017	3.43	**52.1**	ND	13.5	ND	ND	69.03	ND	ND	ND	ND	ND
	11/26/2018	**11.7**	**133**	ND	52.7	51.8 J	ND	249.20	ND	ND	ND	ND	ND
MW-66	12/16/2015	**7.98**	**65.4**	ND	30.0	ND	ND	103.81	ND	0.43 J	ND	ND	ND
	2/18/2016	**7.19**	**54.9**	ND	17.3	ND	ND	79.89	ND	0.50 J	ND	ND	ND
	5/16/2016	**5.98**	**48.6**	1.05 J	16.2	ND	ND	71.80	ND	ND	ND	ND	ND
	8/30/2016	**4.74**	**45.0**	ND	12.4	ND	ND	62.14	ND	ND	ND	ND	ND
	11/15/2016	**6.00**	**52.2**	ND	18.0	ND	ND	76.20	ND	ND	ND	ND	ND
	2/22/2017	**9.63**	**120**	ND	117	ND	ND	246.63	ND	ND	ND	ND	ND
	5/8/2017	**6.95**	**52.9**	ND	28.0	ND	ND	87.85	ND	ND	ND	ND	ND
	8/14/2017	**6.65**	**54.7**	ND	35.4	ND	ND	96.75	ND	ND	ND	ND	ND
	11/16/2017	**7.04**	**56.1**	ND	39.0	ND	ND	102.14	ND	ND	ND	ND	ND
	2/20/2018	**10.5**	**80.7**	ND	49.7	ND	ND	140.90	ND	ND	ND	ND	ND
	5/24/2018	**14.2**	**98.7**	1.30 J	64.8	ND	ND	179.00	ND	ND	ND	ND	ND
	8/23/2018	**13.3**	**83.3**	ND	54.3	ND	ND	150.90	ND	ND	ND	ND	ND
	11/27/2018	**11.7**	**77.3**	ND	40.1	ND	ND	143.20	ND	ND	ND	ND	14.1
	2/19/2019	**6.26**	**42.4**	ND	22.0	ND	ND	70.66	ND	ND	ND	ND	ND
	5/14/2019	**14.9**	**100**	ND	52.4	ND	ND	167.30	ND	ND	ND	ND	ND

Table 2
Former AT&T Richmond Works Facility
Surface Water and Groundwater Monitoring Results, ug/l
Baseline Data for Shutdown begins in January 2016

Location	Date Sampled	1,1-DCA	1,1-DCE	MEC	1,1,1-TCA	1,4-Dioxane	Vinyl Chloride	TOTAL VOCs	Chloro-ethane	Chloroform	PCE	TCE	Other VOCs
Clean-up Goal, µg/l	mm/dd/yyyy	4	7	5	200	NA	NA	--	NA	NA	NA	NA	NA
Off-Site Monitoring Wells													
MW-31	11/11/2015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/17/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/15/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/27/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-32	11/11/2015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/17/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/15/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/27/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-50	11/11/2015	1.54	**19.2**	ND	2.05	6.57	ND	29.36	ND	ND	ND	ND	ND
	1/13/2016	1.03	**12.3**	ND	1.22	3.91	ND	18.46	ND	ND	ND	ND	ND
	2/17/2016	0.56 J	**7.01**	ND	ND	2.71	ND	10.28	ND	ND	ND	ND	ND
	3/23/2016	1.08	**13.0**	ND	1.12	5.00	ND	20.20	ND	ND	ND	ND	ND
	4/19/2016	1.66	**18.6**	1.58 J	1.5	8.17	ND	31.51	ND	ND	ND	ND	ND
	5/18/2016	0.92 J	**10.3**	ND	0.83 J	4.30	ND	16.35	ND	ND	ND	ND	ND
	6/28/2016	0.57 J	**7.60**	1.40 J	ND	2.32	ND	11.89	ND	ND	ND	ND	ND
	9/1/2016	3.15	**48.2**	ND	3.62	12.30	ND	67.27	ND	ND	ND	ND	ND
	11/17/2016	3.35	**48.9**	ND	3.77	14.10	ND	70.57	ND	0.45 J	ND	ND	ND
	2/21/2017	2.32	**29.5**	ND	2.88	11.00	ND	55.90	ND	ND	ND	ND	10.2
	5/10/2017	2.48	**31.1**	ND	3.26	11.3	ND	48.14	ND	ND	ND	ND	ND
	8/15/2017	**6.59**	**95.6**	ND	10.5	30.5	ND	143.68	ND	0.49 J	ND	ND	ND
	11/15/2017	3.39	**41.5**	ND	5.08	20.7	ND	70.67	ND	ND	ND	ND	ND
	2/20/2018	3.40	**42.3**	ND	4.43	11.8	ND	61.93	ND	ND	ND	ND	ND
	5/23/2018	1.45	**19.5**	ND	1.95	10.8	ND	33.70	ND	ND	ND	ND	ND
	8/22/2018	3.06	**44.0**	ND	3.66	21.7	ND	72.42	ND	ND	ND	ND	ND
	11/29/2018	1.41	**19.0**	ND	1.40	5.98	ND	27.79	ND	ND	ND	ND	ND
	2/19/2019	0.76 J	**8.82**	ND	0.70 J	3.32	ND	13.60	ND	ND	ND	ND	ND
	5/15/2019	0.75 J	**10.2**	ND	0.73 J	4.91	ND	16.59	ND	ND	ND	ND	ND
MW-51	11/11/2015	3.42	**51.2**	ND	6.93	22.8	ND	84.35	ND	ND	ND	ND	ND
	1/13/2016	3.01	**40.4**	ND	5.45	14.6	ND	63.46	ND	ND	ND	ND	ND
	2/17/2016	3.01	**42.3**	1.55 J	5.73	17.6	ND	70.99	ND	ND	ND	ND	0.80 J
	3/23/2016	2.58	**35.1**	ND	4.54	21.2	ND	63.42	ND	ND	ND	ND	ND
	4/19/2016	3.52	**54.8**	1.17 J	6.53	17.3	ND	83.32	ND	ND	ND	ND	ND
	5/18/2016	**4.60**	**63.7**	ND	7.73	28.2	ND	104.23	ND	ND	ND	ND	ND
	6/28/2016	**4.70**	**71.4**	ND	7.90	25.9	ND	109.90	ND	ND	ND	ND	ND
	9/1/2016	**7.70**	**121**	ND	13.5	38.7	ND	180.90	ND	ND	ND	ND	ND
	10/18/2016	**8.55**	**116**	ND	12.9	50.0	ND	187.86	ND	0.41 J	ND	ND	ND
	11/17/2016	**10.1**	**128**	ND	14.2	51.4	ND	204.16	ND	0.46 J	ND	ND	ND
	1/12/2017	**10.7**	**120**	ND	10.9	49.1	ND	190.70	ND	ND	ND	ND	ND
	2/21/2017	**13.4**	**134**	ND	14.6	50.1	ND	212.52	ND	0.42 J	ND	ND	ND
	5/10/2017	**10.1**	**128**	ND	13.3	54.0	ND	205.40	ND	ND	ND	ND	ND
	8/15/2017	**12.0**	**137**	ND	12.7	62.4	ND	224.52	ND	0.42 J	ND	ND	ND
	11/15/2017	**9.80**	**111**	ND	10.7	48.8	ND	180.30	ND	ND	ND	ND	ND
	2/20/2018	**13.7**	**131**	ND	11.6	50.8	ND	207.10	ND	ND	ND	ND	ND
	5/23/2018	**11.0**	**116**	ND	10.4	61.4	ND	198.80	ND	ND	ND	ND	ND
	8/22/2018	**9.80**	**99.8**	ND	9.25	45.7	ND	164.55	ND	ND	ND	ND	ND
	11/29/2018	**10.7**	**104**	ND	8.93	49.5	ND	180.22	ND	ND	ND	ND	7.09 J
	2/19/2019	**17.5**	**145**	ND	17.5	47.0	ND	227.00	ND	ND	ND	ND	ND
	5/15/2019	**11.0**	**113**	ND	14.0	55.0	ND	200.43	ND	ND	ND	ND	7.43 J

Table 2 Former AT&T Richmond Works Facility Surface Water and Groundwater Monitoring Results, ug/l Baseline Data for Shutdown begins in January 2016													
Location	**Date Sampled**	**1,1-DCA**	**1,1-DCE**	**MEC**	**1,1,1-TCA**	**1,4-Dioxane**	**Vinyl Chloride**	**TOTAL VOCs**	**Chloro-ethane**	**Chloroform**	**PCE**	**TCE**	**Other VOCs**
Clean-up Goal, µg/l	**mm/dd/yyyy**	**4**	**7**	**5**	**200**	**NA**	**NA**	**--**	**NA**	**NA**	**NA**	**NA**	**NA**
MW-52	11/11/2015	**7.30**	**27.8**	ND	2.42	11.6	ND	49.12	ND	ND	ND	ND	ND
	2/17/2016	**4.58**	**10.1**	ND	ND	6.93	0.42 J	22.03	ND	ND	ND	ND	ND
	5/18/2016	3.97	**12.1**	ND	ND	5.41	0.71	22.19	ND	ND	ND	ND	ND
	9/1/2016	3.63	**12.5**	ND	ND	5.15	0.41 J	21.69	ND	ND	ND	ND	ND
	11/17/2016	**5.43**	**27.7**	ND	ND	5.35	0.44 J	38.92	ND	ND	ND	ND	ND
	2/21/2017	**7.59**	**49.2**	ND	ND	11.1	0.42 J	68.31	ND	ND	ND	ND	ND
	5/10/2017	**11.7**	**81.7**	ND	ND	14.7	0.65	108.75	ND	ND	ND	ND	ND
	8/15/2017	**7.54**	**60.2**	ND	ND	14.3	0.86	83.53	ND	ND	ND	ND	0.63
	11/15/2017	**5.79**	**46.4**	ND	ND	9.07	0.64	61.90	ND	ND	ND	ND	ND
	2/20/2018	**6.04**	**51.5**	ND	ND	6.03	0.84	64.41	ND	ND	ND	ND	ND
	5/23/2018	**4.94**	**42.3**	ND	ND	9.55	ND	56.79	ND	ND	ND	ND	ND
	8/22/2018	**5.22**	**50.1**	ND	ND	9.56	1.10	65.98	ND	ND	ND	ND	ND
	11/29/2018	**5.06**	**44.3**	ND	ND	8.54	0.64	58.54	ND	ND	ND	ND	ND
	2/19/2019	**6.29**	**58.4**	ND	ND	11.2	0.55	76.44	ND	ND	ND	ND	ND
	5/15/2019	**5.69**	**56.2**	ND	ND	9.80	0.85	72.54	ND	ND	ND	ND	ND
MW-53	11/11/2015	0.48 J	1.83	ND	ND	ND	ND	2.31	ND	ND	ND	ND	ND
	1/13/2016	0.65 J	0.48 J	ND	ND	ND	0.69	1.82	ND	ND	ND	ND	ND
	2/17/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	3/23/2016	2.47	5.76	ND	ND	2.14	3.76	14.13	ND	ND	ND	ND	ND
	4/19/2016	4.43	13.0	1.51 J	ND	3.49	6.14	28.57	ND	ND	ND	ND	ND
	5/18/2016	0.82 J	2.10	ND	ND	ND	1.22	4.14	ND	ND	ND	ND	ND
	6/28/2016	ND	0.54 J	1.50 J	ND	ND	0.33 J	2.37	ND	ND	ND	ND	ND
	9/1/2016	**5.10**	**18.1**	ND	ND	5.23	5.96	34.39	ND	ND	ND	ND	ND
	11/17/2016	**4.48**	**9.28**	ND	ND	3.38	6.37	23.51	ND	ND	ND	ND	ND
	2/21/2017	3.20	6.42	ND	ND	3.31	4.60	17.53	ND	ND	ND	ND	ND
	5/10/2017	1.95	2.14	ND	ND	ND	3.24	7.33	ND	ND	ND	ND	ND
	8/15/2017	3.81	7.85	ND	ND	ND	7.42	19.08	ND	ND	ND	ND	ND
	11/15/2017	1.79	3.34	ND	ND	ND	3.89	9.02	ND	ND	ND	ND	ND
	2/20/2018	0.61 J	0.68 J	ND	ND	ND	1.11	2.40	ND	ND	ND	ND	ND
	5/23/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	8/22/2018	3.40	**8.69**	ND	ND	3.30	9.65	25.04	ND	ND	ND	ND	ND
	11/29/2018	2.76	**7.15**	ND	ND	3.14	7.42	30.13	ND	ND	ND	ND	9.66 J
	2/19/2019	0.64 J	3.27	ND	ND	ND	0.51	4.42	ND	ND	ND	ND	ND
	5/15/2019	1.36	2.62	ND	ND	ND	4.12	8.10	ND	ND	ND	ND	ND
MW-54	11/11/2015	ND	0.53 J	ND	ND	ND	ND	0.53	ND	ND	ND	ND	ND
	1/13/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/17/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	3/23/2016	ND	ND	1.22 J	ND	ND	ND	1.22	ND	ND	ND	ND	ND
	4/19/2016	ND	0.60 J	1.86 J	ND	ND	ND	2.46	ND	ND	ND	ND	ND
	5/18/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/28/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	9/1/2016	ND	1.06	ND	ND	ND	ND	1.06	ND	ND	ND	ND	ND
	11/17/2016	ND	0.30 J	ND	ND	ND	ND	0.30	ND	ND	ND	ND	ND
	2/21/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/10/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	8/15/2017	ND	1.27	ND	ND	ND	ND	1.27	ND	ND	ND	ND	ND
	11/15/2017	ND	0.44 J	ND	ND	ND	ND	0.44	ND	ND	ND	ND	ND
	2/20/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/23/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	8/22/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/29/2018	ND	ND	ND	ND	ND	ND	9.87	ND	ND	ND	ND	9.87 J
	2/19/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/15/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 2
Former AT&T Richmond Works Facility
Surface Water and Groundwater Monitoring Results, ug/l
Baseline Data for Shutdown begins in January 2016

Location	Date Sampled	1,1-DCA	1,1-DCE	MEC	1,1,1-TCA	1,4-Dioxane	Vinyl Chloride	TOTAL VOCs	Chloro-ethane	Chloroform	PCE	TCE	Other VOCs
Clean-up Goal, µg/l	mm/dd/yyyy	4	7	5	200	NA	NA	--	NA	NA	NA	NA	NA
MW-55	11/11/2015	ND	ND	ND	1.53	ND	ND	1.53	ND	ND	ND	ND	ND
	1/13/2016	ND	ND	ND	0.71 J	ND	ND	0.71	ND	ND	ND	ND	ND
	2/17/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	3/23/2016	ND	ND	1.47 J	1.14	ND	ND	2.61	ND	ND	ND	ND	ND
	4/19/2016	ND	ND	2.01 J	1.37	ND	ND	3.38	ND	ND	ND	ND	ND
	5/18/2016	ND	ND	ND	0.77 J	ND	ND	0.77	ND	ND	ND	ND	ND
	6/28/2016	ND	ND	ND	1.34	ND	ND	1.34	ND	ND	ND	ND	ND
	9/1/2016	ND	ND	ND	2.07	ND	ND	2.07	ND	ND	ND	ND	ND
	11/17/2016	ND	ND	ND	1.24	ND	ND	1.24	ND	ND	ND	ND	ND
	2/21/2017	ND	ND	ND	1.50	ND	ND	1.50	ND	ND	ND	ND	ND
	5/10/2017	ND	ND	ND	1.62	ND	ND	1.62	ND	ND	ND	ND	ND
	8/15/2017	ND	ND	ND	1.00 J	ND	ND	1.00	ND	ND	ND	ND	ND
	11/15/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/20/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/23/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	8/22/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/29/2018	ND	ND	ND	ND	ND	ND	8.32	ND	ND	ND	ND	8.32 J
	2/19/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/15/2019	ND	ND	ND	0.79 J	ND	ND	0.79	ND	ND	ND	ND	ND
MW-56	11/11/2015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/13/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/17/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	3/23/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/19/2016	ND	ND	1.31 J	ND	ND	ND	1.31	ND	ND	ND	ND	ND
	5/18/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	9/1/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/17/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/21/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/10/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	8/15/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/15/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/20/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/23/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	8/22/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/29/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/19/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/15/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-62	11/11/2015	1.40	**12.2**	ND	2.21	ND	ND	15.81	ND	ND	ND	ND	ND
	2/17/2016	3.32	**36.8**	ND	5.22	ND	ND	45.86	ND	0.52	ND	ND	ND
	5/18/2016	3.53	**55.6**	ND	5.95	ND	ND	65.08	ND	ND	ND	ND	ND
	9/1/2016	2.26	**22.0**	ND	2.96	ND	ND	27.22	ND	ND	ND	ND	ND
	11/17/2016	2.92	**34.2**	ND	3.91	ND	ND	41.03	ND	ND	ND	ND	ND
	2/21/2017	3.24	**39.5**	ND	4.54	ND	ND	47.28	ND	ND	ND	ND	ND
	5/10/2017	3.93	**46.8**	ND	5.00	ND	ND	55.73	ND	ND	ND	ND	ND
	8/15/2017	3.26	**33.8**	ND	4.20	ND	ND	42.41	ND	ND	ND	ND	1.15 J
	11/15/2017	3.72	**39.9**	ND	4.78	ND	ND	48.40	ND	ND	ND	ND	ND
	2/20/2018	**6.28**	**75.0**	ND	7.39	ND	ND	88.67	ND	ND	ND	ND	ND
	5/23/2018	**5.76**	**57.2**	ND	5.96	42.6 J	ND	112.04	ND	0.52	ND	ND	ND
	8/22/2018	2.93	**27.7**	ND	3.53	ND	ND	34.16	ND	ND	ND	ND	ND
	11/29/2018	**4.76**	**34.8**	ND	3.64	ND	ND	43.20	ND	ND	ND	ND	ND
	2/19/2019	**6.64**	**78.0**	ND	7.50	ND	ND	92.14	ND	ND	ND	ND	ND
	5/15/2019	**4.53**	**39.1**	ND	4.89	ND	ND	48.52	ND	ND	ND	ND	ND

Table 2 Former AT&T Richmond Works Facility Surface Water and Groundwater Monitoring Results, ug/l Baseline Data for Shutdown begins in January 2016													
Location	**Date Sampled**	**1,1-DCA**	**1,1-DCE**	**MEC**	**1,1,1-TCA**	**1,4-Dioxane**	**Vinyl Chloride**	**TOTAL VOCs**	**Chloro-ethane**	**Chloroform**	**PCE**	**TCE**	**Other VOCs**
Clean-up Goal, µg/l	**mm/dd/yyyy**	**4**	**7**	**5**	**200**	**NA**	**NA**	**--**	**NA**	**NA**	**NA**	**NA**	**NA**
MW-63	11/11/2015	**5.75**	**87.9**	ND	13.6	ND	ND	107.69	ND	0.44 J	ND	ND	ND
	5/18/2016	**6.89**	**106**	ND	15.1	ND	ND	127.99	ND	ND	ND	ND	ND
	11/17/2016	**7.37**	**69.9**	ND	10.7	45.6 J	ND	133.57	ND	ND	ND	ND	ND
	5/10/2017	**11.7**	**153**	ND	21.0	67.9 J	ND	254.06	ND	0.46 J	ND	ND	ND
	11/16/2017	**8.78**	**109**	ND	17.3	71.5 J	ND	206.58	ND	ND	ND	ND	ND
	5/23/2018	**11.3**	**156**	ND	26.3	46.9 J	ND	240.50	ND	ND	ND	ND	ND
	11/28/2018	**11.1**	**184**	ND	21.8	76.4 J	ND	293.30	ND	ND	ND	ND	ND
	5/14/2019	**15.3**	**169**	ND	28.3	ND	ND	212.60	ND	ND	ND	ND	ND
MW-64	11/11/2015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/18/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/17/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/10/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/15/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/23/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/29/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/15/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-65	11/11/2015	ND	ND	ND	0.71 J	ND	ND	0.71	ND	ND	ND	ND	ND
	5/18/2016	ND	ND	ND	1.66	ND	ND	1.66	ND	ND	ND	ND	ND
	11/17/2016	ND	ND	ND	1.57	ND	ND	1.57	ND	ND	ND	ND	ND
	5/10/2017	ND	ND	ND	1.03	ND	ND	1.03	ND	ND	ND	ND	ND
	11/15/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/23/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/29/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/15/2019	ND	ND	ND	0.89 J	ND	ND	0.89	ND	ND	ND	ND	ND

Table 2
Former AT&T Richmond Works Facility
Surface Water and Groundwater Monitoring Results, ug/l
Baseline Data for Shutdown begins in January 2016

Location	Date Sampled	1,1-DCA	1,1-DCE	MEC	1,1,1-TCA	1,4-Dioxane	Vinyl Chloride	TOTAL VOCs	Chloro-ethane	Chloroform	PCE	TCE	Other VOCs
Clean-up Goal, µg/l	mm/dd/yyyy	4	7	5	200	NA	NA	--	NA	NA	NA	NA	NA
Extraction Wells													
EW-1	11/12/2015	**11.6**	**158**	ND	34.3	92.8 J	ND	296.70	ND	ND	ND	ND	ND
	5/19/2016	**12.3**	**137**	ND	34.4	ND	ND	183.70	ND	ND	ND	ND	ND
	7/20/2016	**15.3**	**185**	3.76 J	44.1	76.1	ND	324.79	ND	0.53	ND	ND	ND
	11/16/2016	**15.9**	**179**	ND	48.7	62.8 J	ND	306.92	ND	0.52	ND	ND	ND
	5/11/2017	**15.9**	**198**	ND	53.1	84.6 J	ND	352.12	ND	0.52	ND	ND	ND
	11/17/2017	**11.6**	**147**	ND	35.8	61.6 J	ND	256.00	ND	ND	ND	ND	ND
	5/24/2018	**7.02**	**71.7**	ND	11.7	ND	ND	97.71	ND	ND	ND	ND	7.29 J
	11/28/2018	**14.1**	**54.4**	ND	7.36	ND	ND	75.86	ND	ND	ND	ND	ND
	5/16/2019	**24.4**	**90.2**	ND	12.1	ND	0.70	127.40	ND	ND	ND	ND	ND
EW-2	11/12/2015	**17.0**	**216**	ND	27.3	161	ND	422.25	ND	0.55	0.40 J	ND	ND
	5/19/2016	**16.8**	**163**	ND	19.6	125	ND	324.40	ND	ND	ND	ND	ND
	11/16/2016	**19.3**	**161**	ND	17.9	68.6 J	ND	267.20	ND	0.40 J	ND	ND	ND
	5/11/2017	**17.9**	**143**	ND	15.2	66.1 J	ND	242.20	ND	ND	ND	ND	ND
	11/17/2017	**17.8**	**158**	ND	23.9	95.0 J	ND	294.70	ND	ND	ND	ND	ND
	5/24/2018	**26.3**	**206**	ND	21.3	110	ND	364.16	ND	0.56	ND	ND	ND
	11/28/2018	**12.6**	**62.5**	1.13 J	12.6	ND	0.50	89.33	ND	ND	ND	ND	ND
	5/16/2019	**16.2**	**72.9**	ND	14.3	46.0 J	1.23	150.63	ND	ND	ND	ND	ND
EW-3	11/12/2015	**51.5**	**88.1**	ND	14.3	89.1	4.08	243.93	0.93 J	ND	ND	ND	ND
	5/19/2016	**85.0**	**76.7**	ND	38.5	ND	14.3	216.16	1.51	ND	ND	ND	0.15 J
	11/16/2016	**164**	**136**	ND	74.3	56.1 J	27.6	460.83	1.76	ND	ND	ND	1.07 J
	5/9/2017	**67.3**	**61.1**	ND	27.5	ND	6.16	162.92	0.86 J	ND	ND	ND	ND
	11/17/2017	**30.8**	**56.3**	ND	20.7	ND	0.98	108.78	ND	ND	ND	ND	ND
	5/24/2018	**60.6**	**81.6**	ND	27.7	ND	1.68	171.58	ND	ND	ND	ND	ND
	11/28/2018	**191**	**246**	ND	56.0	74.6 J	16.6	585.28	1.08	ND	ND	ND	ND
	5/16/2019	2.02	4.12	ND	1.67	ND	ND	17.91	ND	ND	ND	ND	10.1
EW-4	11/12/2015	**7.93**	**123**	ND	3.26	ND	ND	135.03	ND	ND	ND	ND	0.84 J
	5/19/2016	**11.6**	**203**	ND	3.19	ND	ND	219.09	ND	0.42 J	ND	ND	0.88 J
	11/16/2016	**7.00**	**104**	ND	1.76	ND	ND	113.75	ND	0.46 J	ND	ND	0.99 J
	5/9/2017	**11.7**	**163**	ND	3.86	ND	ND	179.62	ND	0.43 J	ND	ND	0.63 J
	11/17/2017	**7.16**	**110**	ND	1.52	ND	0.42 J	119.59	ND	ND	ND	ND	0.49 J
	5/25/2018	**5.06**	**65.6**	ND	2.45	ND	ND	74.77	ND	ND	ND	ND	1.66
	11/28/2018	**6.92**	**94.8**	ND	1.83	ND	ND	103.55	ND	ND	ND	ND	ND
	5/14/2019	2.68	**42.6**	ND	0.94 J	ND	ND	46.22	ND	ND	ND	ND	ND
EW-5	11/12/2015	0.52 J	**9.98**	ND	ND	ND	ND	10.50	ND	ND	ND	ND	ND
	5/19/2016	ND	1.16	ND	ND	ND	ND	1.16	ND	ND	ND	ND	ND
	11/16/2016	ND	0.54 J	ND	ND	ND	ND	0.54	ND	ND	ND	ND	ND
	5/9/2017	ND	1.32	ND	ND	ND	ND	1.32	ND	ND	ND	ND	ND
	11/17/2017	ND	0.81 J	ND	0.95 J	ND	ND	1.76	ND	ND	ND	ND	ND
	5/25/2018	ND	1.56	ND	ND	ND	ND	1.56	ND	ND	ND	ND	ND
	11/28/2018	0.92 J	**18.0**	ND	0.97 J	ND	0.71	20.60	ND	ND	ND	ND	ND
	5/14/2019	0.74 J	**8.45**	ND	1.32	ND	ND	10.51	ND	ND	ND	ND	ND
EW-6	11/12/2015	0.71 J	**11.8**	ND	3.34	ND	ND	15.85	ND	ND	ND	ND	ND
	5/19/2016	ND	1.66	ND	1.49	ND	ND	3.15	ND	ND	ND	ND	ND
	11/16/2016	2.06	2.69	ND	0.98 J	ND	ND	5.73	ND	ND	ND	ND	ND
	5/9/2017	1.41	7.00	ND	2.37	ND	ND	10.78	ND	ND	ND	ND	ND
	11/17/2017	0.68 J	4.75	ND	0.86 J	ND	ND	6.29	ND	ND	ND	ND	ND
	5/24/2018	ND	0.74 J	ND	ND	ND	ND	0.74	ND	ND	ND	ND	ND
	11/28/2018	ND	1.16	ND	ND	ND	ND	1.16	ND	ND	ND	ND	ND
	5/16/2019	0.98 J	1.98	ND	ND	ND	ND	2.96	ND	ND	ND	ND	ND
EW-7	11/12/2015	0.55 J	1.32	ND	1.37	ND	ND	3.24	ND	ND	ND	ND	ND
	5/19/2016	ND	0.69 J	ND	0.94 J	ND	ND	1.63	ND	ND	ND	ND	ND
	11/16/2016	0.55 J	0.72 J	ND	ND	ND	ND	1.27	ND	ND	ND	ND	ND
	5/9/2017	0.75 J	1.79	ND	1.78	ND	ND	4.32	ND	ND	ND	ND	ND
	11/17/2017	ND	0.77 J	ND	ND	ND	ND	0.77	ND	ND	ND	ND	ND
	5/24/2018	ND	2.54	ND	2.12	ND	ND	4.66	ND	ND	ND	ND	ND

Table 2
Former AT&T Richmond Works Facility
Surface Water and Groundwater Monitoring Results, ug/l
Baseline Data for Shutdown begins in January 2016

Location	Date Sampled	1,1-DCA	1,1-DCE	MEC	1,1,1-TCA	1,4-Dioxane	Vinyl Chloride	TOTAL VOCs	Chloro-ethane	Chloroform	PCE	TCE	Other VOCs
Clean-up Goal, µg/l	mm/dd/yyyy	4	7	5	200	NA	NA	--	NA	NA	NA	NA	NA
EW-8	11/12/2015	1.57	1.93	ND	5.70	ND	ND	9.20	ND	ND	ND	ND	ND
	5/19/2016	0.50 J	0.50 J	ND	1.88	ND	ND	2.88	ND	ND	ND	ND	ND
	11/16/2016	1.80	1.31	ND	4.16	ND	ND	7.27	ND	ND	ND	ND	ND
	5/9/2017	1.93	1.84	ND	5.95	ND	ND	9.72	ND	ND	ND	ND	ND
	11/17/2017	1.90	2.90	ND	4.50	ND	ND	9.30	ND	ND	ND	ND	ND
	5/24/2018	2.29	3.13	ND	5.84	ND	ND	11.26	ND	ND	ND	ND	ND
EW-9	11/12/2015	**76.3**	**1080**	ND	**878**	163	2.44	2202.12	0.52 J	0.64	0.59 J	0.63 J	ND
	2/16/2016	**21.5**	**89.0**	ND	106	107	6.63	330.13	ND	ND	ND	ND	ND
	5/17/2016	**182**	**659**	ND	**897**	ND	2.72	1740.72	ND	ND	ND	ND	ND
	6/27/2016	**155**	**272**	2.48 J	**802**	249	1.91	1497.36	ND	ND	ND	ND	14.97
	8/30/2016	**256**	**213**	**6.04**	**1390**	289	1.87	2215.85	ND	0.47 J	ND	0.46 J	59.01 J
	11/16/2016	**165**	**273**	**7.32**	**636**	233	1.64	1357.20	ND	0.48 J	ND	0.41 J	40.35 J
	2/20/2017	**86.5**	**421**	1.29 J	**765**	157	1.68	1438.38	0.68 J	0.63	0.61 J	0.76 J	3.23
	5/9/2017	**78.7**	**563**	3.03 J	**539**	122	3.89	1313.17	0.55 J	0.80	ND	0.73 J	1.47 J
	8/14/2017	**76.3**	**500**	ND	**545**	119	10.70	1257.35	ND	1.01	0.57 J	0.68 J	4.09 J
	11/16/2017	**78.4**	**741**	2.72 J	**750**	124	18.2	1722.27	ND	0.94	0.54 J	0.65 J	5.82
	2/19/2018	**56.7**	**232**	2.52 J	**689**	104	9.34	1100.54	ND	0.85	ND	0.44 J	5.69 J
	5/24/2018	**102**	**454**	1.88 J	**474**	213	36.2	1289.19	ND	0.54	ND	ND	7.57 J
	8/22/2018	**43.6**	**379**	2.43 J	**607**	118	4.77	1159.86	ND	1.12	0.47 J	0.58 J	2.89 J
	11/28/2018	**21.9**	**199**	1.54 J	**272**	43.0 J	1.29	539.32	ND	0.59	ND	ND	ND
	2/19/2019	3.63	**49.3**	ND	37.8	ND	ND	90.73	ND	ND	ND	ND	ND
	5/14/2019	**52.1**	**578**	ND	**538**	87.1 J	5.69	1263.21	ND	0.98	0.57 J	0.77 J	ND
EW-10	11/12/2015	**82.6**	**1360**	**120**	**3450**	408	0.75	5424.84	ND	1.27	0.71 J	1.05	0.46 J
	2/16/2016	**184**	**1230**	**16.4**	**2180**	521	12.4	4146.14	ND	0.72	ND	0.42 J	1.20
	5/16/2016	2.79	**17.9**	4.98	34.7	ND	ND	60.37	ND	ND	ND	ND	ND
	6/27/2016	**167**	**225**	**670**	**2450**	554	5.53	4099.29	0.41 J	0.49 J	ND	0.35 J	26.51
	8/30/2016	**360**	**393**	**1640**	**5170**	1240	4.64	8843.60	0.80 J	1.13	0.45 J	1.16	32.42 J
	11/16/2016	**79.1**	**676**	**84.1**	**661**	187	1.28	1688.48	ND	ND	ND	ND	ND
	2/22/2017	**380**	**1890**	**27.7**	**1330**	971	1.95	4625.14	ND	1.14	0.46 J	1.13	21.76
	5/8/2017	**207**	**1300**	**8.46**	**649**	335	0.78	2510.49	ND	0.64	ND	0.77 J	8.84 J
	8/16/2017	**392**	**3110**	3.03 J	**768**	589	2.66	4872.11	ND	1.35	1.23	1.52	3.32 J
	11/17/2017	**161**	**1590**	2.57 J	**285**	162	1.26	2203.64	ND	0.56	0.56 J	0.69 J	ND
	2/20/2018	**103**	**632**	2.05 J	**320**	137	0.84	1195.92	ND	0.53	ND	0.50 J	ND
	5/24/2018	**132**	**781**	3.33 J	**668**	137	1.44	1725.01	ND	0.95	0.49 J	0.80 J	ND
	8/23/2018	**154**	**1100**	2.21 J	**356**	250	2.20	1866.55	ND	0.97	0.47 J	0.70 J	ND
	11/28/2018	**152**	**890**	ND	**261**	198	1.40	1504.01	ND	0.96	ND	0.65 J	ND
	2/19/2019	**248**	**1820**	1.27 J	**332**	252	1.44	2657.72	ND	1.55	0.55 J	0.91 J	ND
	5/14/2019	**593**	**2050**	**39.3**	**292**	429	7.89	3443.28	29.7	1.36	ND	1.03	ND
EW-11	11/12/2015	**4.20**	**33.4**	ND	111	ND	ND	150.12	ND	1.52	ND	ND	ND
	2/16/2016	**4.24**	**20.6**	ND	23.5	ND	ND	56.17	ND	7.83	ND	ND	ND
	5/19/2016	2.85	**13.1**	ND	11.1	ND	ND	32.82	ND	5.77	ND	ND	ND
	9/1/2016	**4.50**	**14.3**	ND	19.4	ND	ND	45.49	ND	7.29	ND	ND	7.29
	11/16/2016	**5.61**	**21.9**	ND	36.5	ND	ND	72.12	ND	8.11	ND	ND	ND
	2/20/2017	**4.43**	**16.6**	ND	26.1	ND	ND	54.77	ND	7.64	ND	ND	ND
	5/11/2017	**4.10**	**15.5**	ND	16.8	ND	ND	43.36	ND	6.56	0.40 J	ND	ND
	8/14/2017	**4.58**	**7.94**	ND	6.97	ND	ND	24.34	ND	3.48	0.81 J	ND	0.56 J
	11/17/2017	**5.99**	**9.39**	ND	9.32	ND	ND	30.05	ND	1.88	3.47	ND	ND
	2/21/2018	**7.74**	6.22	ND	8.43	ND	ND	26.29	ND	0.87	3.03	ND	ND
	5/24/2018	**10.6**	**13.0**	**7.13**	14.4	ND	ND	50.01	ND	1.44	3.44	ND	ND
	11/28/2018	**5.29**	5.48	1.05 J	8.05	ND	ND	21.58	ND	ND	1.71	ND	ND
	5/14/2019	**7.22**	5.90	ND	20.8	ND	ND	34.82	ND	ND	0.90 J	ND	ND

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Former AT&T Richmond Works Facility
Surface Water and Groundwater Monitoring Results, ug/l
Baseline Data for Shutdown begins in January 2016

Location	Date Sampled	1,1-DCA	1,1-DCE	MEC	1,1,1-TCA	1,4-Dioxane	Vinyl Chloride	TOTAL VOCs	Chloro-ethane	Chloroform	PCE	TCE	Other VOCs
Clean-up Goal, µg/l	mm/dd/yyyy	4	7	5	200	NA	NA	--	NA	NA	NA	NA	NA
EW-12	11/12/2015	**5.85**	**20.6**	ND	10.9	ND	ND	37.35	ND	ND	ND	ND	ND
	2/16/2016	**9.20**	1.51	ND	9.52	ND	ND	20.23	ND	ND	ND	ND	ND
	5/19/2016	**4.79**	1.29	ND	7.23	ND	ND	13.31	ND	ND	ND	ND	ND
	9/1/2016	3.48	1.35	ND	14.9	ND	ND	19.73	ND	ND	ND	ND	ND
	11/16/2016	3.43	1.47	ND	11.0	ND	ND	15.90	ND	ND	ND	ND	ND
	2/20/2017	3.80	1.35	ND	8.90	ND	ND	14.05	ND	ND	ND	ND	ND
	5/11/2017	**4.93**	2.26	ND	12.2	ND	ND	19.39	ND	ND	ND	ND	ND
	8/16/2017	**4.69**	2.09	ND	13.8	ND	ND	21.78	ND	ND	ND	ND	1.20 J
	11/17/2017	3.85	2.24	ND	14.1	ND	ND	20.19	ND	ND	ND	ND	ND
	2/21/2018	**4.53**	2.48	ND	14.0	ND	ND	21.01	ND	ND	ND	ND	ND
	5/24/2018	3.21	1.55	ND	8.60	ND	ND	13.36	ND	ND	ND	ND	ND
	8/23/2018	2.55	1.47	ND	17.8	ND	ND	21.82	ND	ND	ND	ND	ND
	11/28/2018	2.82	1.38	ND	13.4	ND	ND	24.98	ND	ND	ND	ND	7.38 J
	5/15/2019	2.15	0.76 J	ND	6.42	ND	ND	9.33	ND	ND	ND	ND	ND
EW-13	11/12/2015	**16.9**	**43.3**	ND	8.12	ND	0.33 J	69.09	0.44 J	ND	ND	ND	ND
	5/19/2016	**18.5**	**25.9**	ND	2.98	ND	1.25	48.63	ND	ND	ND	ND	ND
	11/16/2016	**33.1**	**36.4**	ND	3.94	ND	2.54	76.44	0.46 J	ND	ND	ND	ND
	5/11/2017	**40.8**	**35.7**	ND	4.80	ND	3.62	84.92	ND	ND	ND	ND	ND
	11/17/2017	**35.6**	**37.7**	ND	3.98	ND	5.26	82.54	ND	ND	ND	ND	ND
	5/24/2018	**72.4**	**93.9**	ND	6.22	76.7 J	5.08	263.78	ND	ND	ND	ND	9.48 J
	11/29/2018	**67.8**	**94.7**	ND	6.38	73.7 J	8.50	258.68	ND	ND	ND	ND	7.60 J
	5/16/2019	**53.1**	**86.4**	ND	7.75	63.3 J	4.97	215.52	ND	ND	ND	ND	ND
EW-14	11/12/2015	**175**	**60.9**	ND	8.86	86.4 J	15.6	350.48	3.72	ND	ND	ND	ND
	5/19/2016	**223**	**49.9**	ND	4.47	80.6 J	12.7	374.13	3.46	ND	ND	ND	ND
	11/16/2016	**228**	**106**	ND	4.86	120	36.7	502.42	5.77	ND	ND	ND	1.09 J
	5/11/2017	**122**	**49.3**	ND	3.59	52.4 J	17.0	246.23	1.50	ND	ND	ND	0.44 J
	11/17/2017	**83.3**	**40.7**	ND	3.73	61.4 J	17.2	208.56	1.00 J	ND	ND	ND	1.23 J
	5/24/2018	**83.5**	**83.2**	ND	2.97	62.1 J	18.3	259.17	ND	ND	ND	ND	9.10 J
	11/28/2018	**38.8**	**57.8**	1.09 J	3.95	42.8 J	3.73	148.17	ND	ND	ND	ND	ND
	5/16/2019	**50.0**	**40.6**	ND	3.52	44.8 J	2.82	141.74	ND	ND	ND	ND	ND
EW-15	11/12/2015	**109**	**425**	ND	116	179	10.4	845.12	3.70	0.55	0.48 J	0.63 J	0.36 J
	5/19/2016	**151**	**682**	1.32 J	138	235	9.48	1229.91	2.95	0.69	0.62 J	0.62 J	8.23
	11/18/2016	**109**	**447**	1.26 J	86.1	136	5.48	787.83	1.74	0.54	ND	0.42 J	0.29 J
	5/11/2017	**200**	**975**	3.18 J	146	246	8.75	1584.19	2.72	0.80	0.56 J	0.77 J	0.41 J
	11/17/2017	**144**	**1010**	2.49 J	133	271	13.8	1579.20	2.30	0.59	0.50 J	0.62 J	0.90
	2/19/2018	**231**	**1010**	3.62 J	**215**	311	20.6	1797.98	3.04	0.77	0.52 J	0.76 J	1.67 J
	5/25/2018	**201**	**905**	3.23 J	194	272	14.6	1595.34	2.91	0.85	0.41 J	0.67 J	0.67 J
	8/23/2018	**105**	**582**	1.52 J	103	157	6.83	956.80	1.45	ND	ND	ND	ND
	11/29/2018	**53.1**	**233**	1.08 J	47.6	73.1 J	3.15	411.03	ND	ND	ND	ND	ND
	2/19/2019	**105**	**567**	1.01 J	100	146	5.61	925.88	1.26	ND	ND	ND	ND
	5/15/2019	**93.3**	**492**	ND	86.8	159	6.15	843.64	1.11	ND	ND	ND	5.28 J
EW-16	11/12/2015	**33.1**	**201**	ND	49.9	ND	5.59	293.02	1.72	0.42 J	ND	0.33 J	0.96 J
	5/19/2016	**41.1**	**287**	ND	25.1	ND	16.5	376.32	4.24	0.69	ND	ND	1.69 J
	11/18/2016	**7.18**	**23.5**	ND	1.66	ND	4.81	37.15	ND	ND	ND	ND	ND
	5/11/2017	2.12	**9.12**	ND	ND	ND	0.79	19.32	ND	ND	ND	ND	7.29 J
	11/17/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/25/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/28/2018	1.25	ND	ND	ND	ND	0.57	1.82	ND	ND	ND	ND	ND
	5/14/2019	1.17	2.04	ND	ND	ND	1.89	5.10	ND	ND	ND	ND	ND
EW-17	11/12/2015	2.35	**19.6**	ND	1.87	ND	ND	23.82	ND	ND	ND	ND	ND
	5/19/2016	**7.29**	**86.5**	ND	2.40	ND	ND	97.45	ND	ND	ND	ND	1.26
	11/18/2016	**12.3**	**149**	ND	4.35	ND	7.12	174.87	0.44 J	0.41 J	ND	ND	1.25 J
	5/11/2017	**19.0**	**172**	ND	4.86	ND	6.08	203.63	1.02	ND	ND	ND	0.67 J
	11/17/2017	**10.8**	**143**	ND	2.88	ND	4.83	162.53	ND	0.40 J	ND	ND	0.62 J
	5/25/2018	1.99	**21.3**	ND	0.75 J	ND	ND	24.04	ND	ND	ND	ND	ND
	11/28/2018	**7.23**	**53.2**	ND	0.69 J	ND	17.6	79.13	ND	ND	ND	ND	0.41 J
	5/14/2019	**14.7**	**144**	ND	1.76	ND	7.45	167.91	ND	ND	ND	ND	ND

Table 2 Former AT&T Richmond Works Facility Surface Water and Groundwater Monitoring Results, ug/l Baseline Data for Shutdown begins in January 2016													
Location	**Date Sampled**	**1,1-DCA**	**1,1-DCE**	**MEC**	**1,1,1-TCA**	**1,4-Dioxane**	**Vinyl Chloride**	**TOTAL VOCs**	**Chloro-ethane**	**Chloroform**	**PCE**	**TCE**	**Other VOCs**
Clean-up Goal, µg/l	**mm/dd/yyyy**	**4**	**7**	**5**	**200**	**NA**	**NA**	**--**	**NA**	**NA**	**NA**	**NA**	**NA**
EW-18	11/12/2015	**180**	**423**	**11.0**	**1550**	349	0.69	2513.69	ND	ND	ND	ND	ND
	2/16/2016	0.81 J	0.74 J	ND	ND	ND	ND	1.55	ND	ND	ND	ND	ND
	5/17/2016	1.88	1.64	ND	ND	ND	ND	3.52	ND	ND	ND	ND	ND
	8/30/2016	2.77	3.76	ND	4.28	ND	ND	10.81	ND	ND	ND	ND	ND
	11/16/2016	1.01	1.35	ND	5.99	ND	ND	8.35	ND	ND	ND	ND	ND
	2/22/2017	**59.2**	**228**	**8.48**	**232**	80.1 J	1.35	610.18	ND	ND	ND	ND	1.05
	5/11/2017	**75.3**	**329**	ND	183	110	1.08	698.38	ND	ND	ND	ND	ND
	8/14/2017	**6.21**	**33.4**	ND	21.0	ND	0.60	78.94	ND	ND	ND	ND	17.73 J
	11/16/2017	**818**	**3220**	**883**	**3570**	1640	552	10702.65	8.97	1.00	0.81 J	1.39	7.48 J
	2/19/2018	**988**	**3440**	**869**	**4870**	1730	585	12504.99	11.1	0.93	0.70 J	1.28	8.98 J
	5/24/2018	**20.6**	**104**	3.19 J	122	ND	10.6	260.39	ND	ND	ND	ND	ND
	8/22/2018	**1350**	**3760**	**933**	**3610**	1460	770	11902.01	7.55	0.98	0.89 J	1.46	8.13 J
	11/28/2018	3.38	**24.5**	ND	19.4	ND	1.20	48.91	ND	ND	ND	ND	0.43 J
	2/19/2019	**729**	**2700**	**362**	**1830**	1110	190	6963.52	4.00	0.75	0.76 J	1.33	35.68 J
	5/14/2019	**600**	**2300**	**464**	**1700**	1110	134	6318.69	4.71	0.62	0.66 J	1.14	3.56 J
Surface Water													
SW-15	11/11/2015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/17/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/18/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	9/1/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/17/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/21/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/10/2017	ND	ND	ND	ND	ND	ND	8.16	ND	ND	ND	ND	8.16 J
	8/15/2017	ND	ND	ND	ND	ND	ND	1.19	ND	ND	ND	ND	1.19 J
	11/15/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/20/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/23/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	8/22/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/29/2018	ND	ND	ND	ND	ND	ND	8.39	ND	ND	ND	ND	8.39 J
	2/19/2019	ND	ND	ND	ND	ND	ND	8.07	ND	ND	ND	ND	8.07 J
	5/15/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SW-20	11/11/2015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/19/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/18/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/10/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/15/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/23/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/28/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/14/2019	ND	ND	ND	ND	ND	ND	7.65	ND	ND	ND	ND	7.65 J
SW-21	11/11/2015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/17/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/19/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/17/2016	ND	0.30 J	ND	ND	ND	ND	0.30	ND	ND	ND	ND	ND
	2/21/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/10/2017	ND	ND	ND	ND	ND	ND	8.85	ND	ND	ND	ND	8.85 J
	11/15/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/20/2017	ND	ND	ND	ND	ND	ND	7.50	ND	ND	ND	ND	7.50 J
	5/23/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	8/22/2018	ND	ND	ND	ND	ND	ND	9.83	ND	ND	ND	ND	9.83 J
	11/27/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/19/2019	ND	ND	ND	ND	ND	ND	8.26	ND	ND	ND	ND	8.26 J
	5/15/2019	ND	ND	ND	ND	ND	ND	11.00	ND	ND	ND	ND	11.0

Table 2
Former AT&T Richmond Works Facility
Surface Water and Groundwater Monitoring Results, ug/l
Baseline Data for Shutdown begins in January 2016

Location	Date Sampled	1,1-DCA	1,1-DCE	MEC	1,1,1-TCA	1,4-Dioxane	Vinyl Chloride	TOTAL VOCs	Chloro-ethane	Chloroform	PCE	TCE	Other VOCs
Clean-up Goal, µg/l	mm/dd/yyyy	4	7	5	200	NA	NA	--	NA	NA	NA	NA	NA
SW-67	11/11/2015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/13/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/17/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	3/23/2016	ND	ND	1.65 J	ND	2.04	ND	3.69	ND	ND	ND	ND	ND
	4/19/2016	ND	ND	1.59 J	ND	ND	ND	1.59	ND	ND	ND	ND	ND
	5/18/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/28/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	9/1/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/17/2016	ND	0.45 J	ND	ND	ND	ND	0.45	ND	ND	ND	ND	ND
	2/21/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/10/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	8/15/2017	ND	ND	ND	ND	ND	ND	0.64	ND	ND	ND	ND	0.64 J
	11/15/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/20/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/23/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	8/22/2018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/29/2018	ND	ND	ND	ND	ND	ND	10.40	ND	ND	ND	ND	10.4
	2/19/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/15/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:
Concentrations reported in micrograms per liter (µg/L).
BOLD values exceed respective cleanup goal.
DCA = Dichloroethane, DCE = Dichloroethylene, MEC = Methylene Chloride, TCA = Trichloroethane
PCE = Tetrachloroethylene, TCE = Trichloroethylene, VOC = Volatile Organic Compound
J = Estimated value below the laboratory reporting limit
NA = Not Applicable; ND = Not Detected.
Total VOCs are the sum of the constituents detected with EPA Method 8260B.

Updated By: David Young   Date: June 11, 2019   Checked By: Forrest Hayward   Date: June 13, 2019

Table 3
Soil Assessment Analytical Results
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Soil Boring Location	Sample Depth (ft bgs)	Sample Date (mm/dd/yyyy)	Volatile Organic Compounds by SWMethod 8260B (Site Contaminants of Concern/Interest)								
			1,1,1-Trichloroethane (1,1,1-TCA)	1,1-Dichloroethane (1,1-DCA)	1,1-Dichloroethylene (1,1-DCE)	1,4-Dioxane	Methylene Chloride	Vinyl Chloride	Other VOCs	Total Contaminants of Concern (COCs)	Total VOCs
EPA Residential RSL			**810,000**	**3,600**	**23,000**	**5,300**	**35,000**	**59**	**NE**	**NE**	**NE**
EPA Industrial RSL			**3,600,000**	**16,000**	**100,000**	**24,000**	**320,000**	**1,700**	**NE**	**NE**	**NE**
EPA Risk-Based Protection of Groundwater SSL			**280**	**0.78**	**10**	**0.094**	**2.7**	**0.0065**	**NE**	**NE**	**NE**
Soil Results (ug/kg)											
GP-1	11	2/20/2017	ND	ND	ND	ND	ND	ND	164.2	ND	164.20
GP-6	13	2/20/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND
*GP-6	21	2/20/2017	61.9	ND	66.9	ND	ND	ND	ND	128.80	128.80
GP-7	13	2/20/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND
*GP-7	23	2/20/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND
GP-8	7	2/20/2017	ND	28.8	66.2	ND	ND	ND	ND	95.00	95.00
GP-9	8	2/21/2017	29,800	710	406	ND	ND	ND	ND	30,916.00	30,916.00
GP-10	12	2/21/2017	ND	34.4	ND	ND	7.35	ND	ND	41.75	41.80
GP-11	12	2/21/2017	ND	ND	62.7	ND	ND	ND	22.0	62.70	84.70
GP-12	12	2/21/2017	5.89	7.54	ND	ND	ND	ND	ND	13.43	13.43
GP-14	7	2/21/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND
GP-15	11	2/21/2017	ND	143	32.2	846	ND	ND	ND	175.20	1,021.20
GP-16	11	2/21/2017	ND	26.1	ND	588	ND	ND	ND	26.10	614.10
GP-17	12	2/21/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND
GP-18	8	2/21/2017	90.3	146	69.6	ND	ND	ND	218	305.90	523.90
GP-18	16	2/21/2017	ND	179	42.8	1,130	6,940	ND	ND	7,161.80	8,291.80
GP-19	12	2/22/2017	ND	ND	ND	ND	ND	ND	935.4	ND	935.40
GP-20	16	2/22/2017	ND	22.8	17.3	655	ND	ND	ND	40.10	695.10
GP-21	16	2/22/2017	ND	32.7	ND	2,920	ND	ND	ND	32.70	2,952.70
GP-23	16	2/22/2017	ND	74.5	ND	545	ND	ND	107	74.50	726.50
GP-24	16	2/22/2017	ND	ND	ND	1,250	ND	ND	ND	ND	1,250.00
GP-25	7	2/22/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND
GP-26	12	2/22/2017	ND	24.6	36.8	461	275	ND	29.3	336.40	826.70
GP-28	9	2/23/2017	ND	ND	24.1	ND	ND	ND	40.5	24.10	64.60
GP-28	13	2/23/2017	ND	ND	ND	ND	ND	ND	49.6	ND	49.60
GP-34	4	2/23/2017	8.20	30.3	ND	178	ND	ND	13.3	38.50	229.80
GP-34	12	2/23/2017	6.33	ND	ND	ND	ND	ND	ND	6.33	6.33
GP-35	10	2/23/2017	ND	25.6	ND	ND	ND	ND	147	25.60	172.60
GP-35	12	2/23/2017	ND	13.8	ND	66.9 J	ND	ND	ND	13.80	80.70
GP-36	12	2/23/2017	ND	166	76.9	791	ND	ND	ND	242.90	1,033.90
GP-37	12	2/23/2017	ND	6.00	6.33	56.3 J	ND	ND	ND	12.33	68.63
GP-43	12	2/24/2017	ND	37.1	14.3	ND	ND	ND	ND	51.40	51.40
GP-2018-45	9	10/23/2018	ND	ND	7.39	2,070	ND	ND	119	7.39	2,196.39
GP-2018-45	13	10/23/2018	118	283	22.7	**20,400**	5,330	ND	158.4	5,753.70	26,312.10
GP-2018-46	12	10/23/2018	ND	75.7	22.1	3,980	260	ND	ND	357.80	4,337.80
GP-2018-47	7	10/24/2018	ND	20.3	ND	190	51.5	ND	ND	71.80	261.80
GP-2018-48	11	10/24/2018	ND	143	ND	152	8.32	57.1	58.5	151.32	418.92
GP-2018-49	7	10/23/2018	ND	221	103	1,670	7,110	ND	123.1	7,434.00	9,227.10
GP-2018-49	9	10/23/2018	ND	93.6	10.5	1,630	**143,000**	ND	137.9	143,104.10	144,872.00
GP-2018-50	7	10/23/2018	ND	24.5	8.80	323	147	ND	ND	180.30	503.30
GP-2018-50	10	10/23/2018	ND	13.3	6.59	199	33.3	ND	ND	53.19	252.19
GP-2018-51	12	10/24/2018	ND	145	219	559	5.91	ND	15.2	369.91	944.11
GP-2018-52	5	10/22/2018	ND	ND	ND	ND	8.77	ND	ND	8.77	8.77
GP-2018-53	8	10/22/2018	ND	6.58	ND	ND	57.4	ND	33.2	63.98	97.18
GP-2018-54	12	10/22/2018	ND	157	ND	45.8 J	41.2	ND	ND	198.20	244.00
GP-2018-55	8	10/22/2018	ND	90.2	99.4	ND	27.8	ND	196	217.40	413.40
GP-2018-56	9	10/22/2018	ND	ND	ND	ND	62.5	ND	ND	62.50	62.50
GP-2018-57	8	10/22/2018	ND	ND	ND	ND	11.7	ND	25.2	11.70	36.90
GP-2018-58	8	10/22/2018	ND	ND	ND	ND	50.0	ND	13.3	50.00	63.30
GP-2018-59	5	10/22/2018	ND	ND	ND	ND	43.5	ND	137	43.50	180.50
GP-2018-60	15	10/22/2018	ND	ND	ND	ND	41.7	ND	ND	41.70	41.70
GP-2018-61	9	10/22/2018	ND	ND	ND	ND	43.2	ND	ND	43.20	43.20
GP-2018-62	8	10/22/2018	ND	ND	ND	ND	5.63	ND	ND	5.63	5.63
GP-2018-63	8	10/22/2018	ND	ND	ND	ND	52.7	ND	11.1	52.70	63.80
GP-2018-64	15	10/22/2018	ND	ND	ND	ND	48.3	ND	ND	48.30	48.30
GP-2018-65	15	10/22/2018	ND	ND	ND	ND	52.4	ND	ND	52.40	52.40
GP-2018-66	14	10/22/2018	ND	ND	ND	ND	21.1	ND	ND	21.10	21.10
GP-2018-67	14	10/22/2018	ND	ND	ND	ND	57.1	ND	ND	57.10	57.10
GP-2018-68	14	10/22/2018	ND	ND	ND	ND	25.7	ND	ND	25.70	25.70
GP-2018-69	5	10/22/2018	ND	9.22	5.66	ND	46.7	ND	33.1	61.58	94.68
GP-2018-71	14	10/23/2018	ND	12.8	ND	292	23.8	ND	ND	36.60	328.60

Table 3
Soil Assessment Analytical Results
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Soil Boring Location	Sample Depth (ft bgs)	Sample Date (mm/dd/yyyy)	Volatile Organic Compounds by SWMethod 8260B (Site Contaminants of Concern/Interest)								
			1,1,1-Trichloroethane (1,1,1-TCA)	1,1-Dichloroethane (1,1-DCA)	1,1-Dichloroethylene (1,1-DCE)	1,4-Dioxane	Methylene Chloride	Vinyl Chloride	Other VOCs	Total Contaminants of Concern (COCs)	Total VOCs
EPA Residential RSL			**810,000**	**3,600**	**23,000**	**5,300**	**35,000**	**59**	**NE**	**NE**	**NE**
EPA Industrial RSL			**3,600,000**	**16,000**	**100,000**	**24,000**	**320,000**	**1,700**	**NE**	**NE**	**NE**
EPA Risk-Based Protection of Groundwater SSL			**280**	**0.78**	**10**	**0.094**	**2.7**	**0.0065**	**NE**	**NE**	**NE**
GP-2018-72	13	10/23/2018	ND	47.6	ND	86.2	31.0	ND	ND	78.60	164.80
GP-2018-73	12	10/23/2018	ND	73.6	193	1,070	4,000	12.9	45.91	4,266.60	5,395.41
GP-2018-74	12	10/23/2018	ND	11.0	ND	2,060	104	ND	ND	115.00	2,175.00
GP-2018-75	10	10/23/2018	ND	60.1	8.86	ND	56.2	ND	24.0	125.16	149.16
GP-2018-76	10	10/23/2018	ND	ND	ND	91.0	46.7	ND	10.0	46.70	147.70
GP-2018-77	7	10/23/2018	ND	66.3	162	1,010	ND	ND	ND	228.30	1,238.30
GP-2018-78	10	10/23/2018	ND	60.5	273	1,080	13.3	ND	17.7	346.80	1,444.50
GP-2018-80	8	10/24/2018	ND	10.8	33.6	160	6.14	ND	ND	50.54	210.54
Groundwater Results (ug/L)											
GP-2018-46	groundwater	10/23/2018	6,760	3,270	6,750	9,470	10,600	51.9	168.93	27,380.00	37,070.83
GP-2018-50	groundwater	10/23/2018	707	2,630	11,000	10,300	192,000	7.80	223.92	216,637.00	216,868.72

Notes:

Soil units are in micrograms per kilogram (ug/kg) and groundwater units are in micrograms per liter (ug/L).

Orange Shaded = samples identified by the following screening criteria: 1) concentrations of TCA, MEC, and 1,4-dioxane (constituents of chemicals used in the manufacturing process) that are 100 times the EPA Protection of Groundwater SSLs or greater; 2) located beneath former structures; 3) located beneath concrete pads; and/or 4) believed to be void of utilities.

Soil results are compared to EPA Residential and Industrial RSLs (May 2018). EPA Risk-Based Protection of Groundwater SSLs are included for reference only. Groundwater results are for screening purposes only are are not compared to any standards.

Total Contaminants of Concern (COCs) are the sum of 1,1,1-TCA, 1,1-DCA, 1,1-DCE, and Methylene Chloride.

Total VOCs are the sum of the constituents detected with EPA Method 8260B.

BOLD concentrations exceed their associated EPA Residential Regional Screening Level (RSL).

Shaded concentrations exceed their associated EPA Industrial Regional Screening Level (RSL).

* = Soil sample collected below the water table. Therefore, soil sample may be influenced by groundwater and may not be a representative sample.

GP-2018-70, GP-2018-79, and GP-2018-81 experienced refusal and are not included in this table.

ft bgs = feet below ground surface

EPA = Environmental Protection Agency

RSL = Regional Screening Level

SSL = Soil Screening Level

NE = Not Established

ND = Non-Detect; below laboratory detection limit

J = Estimated value below the laboratory reporting limit

Completed By: David Young Date: November 13, 2018 Checked By: Forrest Hayward Date: November 15, 2018

Table 4
Cleanup Goals
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Contaminant	Cleanup Goal
1,1,1-Trichloroethane (TCA)	200 ug/L
1,1-Dichloroethene (DCE)	7 ug/L
Methylene Chloride (MEC)	5 ug/L
1,1-Dichloroethane (DCA)	4 ug/L

Notes: Cleanup Goals are from 2013 ROD.

Table 5
Volatile Organic Compounds Historically Detected at Site
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Compound	Abbreviation	Origin	First Detected
Methylene Chloride	MEC	Process	1987
1,1,1-Trichloroethane	TCA	Process	1987
1,1-Dichloroethene	DCE	Degradation product of TCA	1987
1,1-Dichloroethane	DCA	Degradation product of TCA	1987
Vinyl Chloride	VC	Degradation product of DCE	1998
Chloroethane	CA	Degradation product of DCA	1998
Tetrachloroethene	PCE	Unknown	1999
Naphthalene	--	Unknown - Petroleum compound	1999
Trichloroethene	TCE	Degradation product of PCE	1999
Acetone	--	Unknown - Common laboratory contaminant	2000
Bromoform	--	Water treatment	2000
Dibromochloromethane	--	Water treatment	2000
Chloroform	--	Unknown - Common laboratory contaminant	2002
Methyl Tertiary Butyl Ether	MTBE	Unknown - Petroleum compound	2004
1,4-Dioxane	--	Associated w/TCA, first analyzed for at low detection levels in 2005	2005
Trichlorofluoromethane	--	Water treatment	2005
Methyl Ethyl Ketone (2-Butanone)	MEK	Unknown - solvent	2008
Dibromomethane	--	Water treatment	2008
Trimethylbenzene	--	Petroleum compound only seen in MW16	2010
Ethylbenzene	--	Petroleum compound only seen in MW16	2010
Styrene	--	Polymer/foam compound only seen in MW16	2010
Toluene	--	Petroleum compound only seen in MW16	2010
n-Propylbenzene	--	Petroleum compound only seen in MW16	2010
Xylenes	--	Petroleum compound only seen in MW16	2010

Table 6
VOC Concentrations at SW21
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Date		Concentration, ug/l							Percent (%) of Total VOCs Detected			
		DCA	DCE	MEC	TCA	1,4-D [15]	VC	Total VOCS	DCA	DCE	MEC	TCA
	Goal	4	7	5	200	6.1[13]	2[13]	-	-	-	-	-
	Dilution Factor											
Mar-89	1	<1.0	52	<5.0	41	NR	NR	93.0	-	55.9	-	44.1
Nov-90	1	1.5	63	<5.0	59	NR	NR	123.5	1.2	51.0	-	47.8
Apr-91	1	2.3	71	<5.0	53	NR	NR	126.3	1.8	56.2	-	42.0
Aug-91	1	1.5	35	<5.0	29	NR	NR	65.5	2.3	53.4	-	44.3
Oct-91	1	2.6	69	<5.0	55	NR	NR	126.6	2.1	54.5	-	43.4
Jan-92	1	2.7	100	<5.0	70	NR	NR	172.7	1.6	57.9	-	40.5
May-92	1	3.2	84	<5.0	51	NR	NR	138.2	2.3	60.8	-	36.9
Jul-92	1	8.1	100	<5.0	81	NR	NR	189.1	4.3	52.9	-	42.8
Nov-92	1	4.6	67	<5.0	51	NR	NR	122.6	3.8	54.6	-	41.6
May-93	1	1.0	34	<5.0	21	NR	NR	56.0	1.8	60.7	-	37.5
Sep-93	1	3.0	45	<5.0	40	NR	NR	88.0	3.4	51.1	-	45.5
Dec-93	1	2.0	42	<5.0	28	NR	NR	72.0	2.8	58.3	-	38.9
Apr-94	1	<1.0	19	<5.0	13	NR	NR	32.0	-	59.4	-	40.6
Feb-95	1	2.3	60	<5.0	35	NR	NR	97.3	2.4	61.7	-	36.0
May-95	1	2.6	64	<5.0	36	NR	NR	102.6	2.5	62.4	-	35.1
Aug-95	1	1.6	20	<5.0	11	NR	NR	32.6	4.9	61.3	-	33.7
Nov-95	1	4.1	100	<5.0	43	NR	NR	147.1	2.8	68.0	-	29.2
May-96	1	2.0	46	<5.0	21	NR	NR	69.0	2.9	66.7	-	30.4
Aug-96	1	2.4	49	<5.0	23	NR	NR	74.4	3.2	65.9	-	30.9
Nov-96	1	<1.0	18	<5.0	7.1	NR	NR	25.1	-	71.7	-	28.3
May-97	1	<1.0	<1.0	<5.0	<1.0	NR	NR	0.0	-	-	-	-
Jul-97	1	<1.0	6.5	<5.0	2.5	NR	NR	9.0	-	72.2	-	27.8
Aug-97	1	<1.0	7.4	<5.0	3	NR	NR	10.4	-	71.2	-	28.8
Feb-98	1	<1.0	6.6	<5.0	2.2	NR	NR	8.8	-	75.0	-	25.0
Jun-98	1	<1.0	16	<5.0	4.7	NR	NR	20.7	-	77.3	-	22.7
Sep-98	1	<1.0	1.2	<5.0	<1.0	NR	NR	1.2	-	100.0	-	-
Nov-98	1	<1.0	4.7	<5.0	1.5	NR	NR	6.2	-	75.8	-	24.2
Feb-99	1	<1.5	12	<5.0	3.3	NR	NR	15.3	-	78.4	-	21.6
Nov-99	1	<1.0	2.9	<1.0	1	NR	NR	3.9	-	74.4	-	25.6
Feb-00	1	<1.0	<1.0	<1.0	<1.0	NR	NR	0.0	-	-	-	-
May-00	1	<10	<10	<20	<10	NR	NR	0.0	-	-	-	-
Nov-00	1	<5	<5	<5	<5	NR	NR	0.0	-	-	-	-
May-01	1	<5	<5	<5	<5	NR	NR	0.0	-	-	-	-
Nov-01	1	<4	<4	<10	<4	NR	NR	0.0	-	-	-	-
Apr-02	1	<1.0	<1.0	<1.0	<1.0	NR	NR	0.0	-	-	-	-
Nov-02	1	<1.0	<1.0	<1.0	<1.0	NR	NR	0.0	-	-	-	-
Apr-03	1	<1.0	<1.0	<1.0	<1.0	NR	NR	3.0	-	-	-	-
Oct-03	1	<1.0	2.7	<1.0	0.4	NR	NR	3.1	-	87.1	-	12.9
Apr-04	1	<1.0	<1.0	<1.0	<1.0	NR	NR	0.8	-	-	-	-
Oct-04	1	<1.0	<1.0	<1.0	<1.0	NR	NR	0.6	-	-	-	-
Apr-05	1	<1.0	0.3	<1.0	<1.0	NR	NR	1.7	-	17.6	-	-
Oct-05	1	<1.0	<1.0	<1.0	<1.0	NR	NR	1.6	-	-	-	-
May-06	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
Oct-06	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.4	-	-	-	-
Apr-07	1	<1.0	<1.0	<4.0	<1.0	NR	NR	2.9	-	-	-	-
Oct-07	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
May-08	1	<1.0	<1.0	<4.0	<1.0	NR	NR	1.2	-	-	-	-
Nov-08	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.6	-	-	-	-
May-09	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.4	-	-	-	-
Oct-09	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
Apr-10	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.2	-	-	-	-
Oct-10	1	<1.0	0.3	<4.0	<1.0	NR	NR	8.1	-	3.7	-	-
Apr-11	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.3	-	-	-	-
Nov-11	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
Apr-12	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.3	-	-	-	-
Nov-12	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.3	-	-	-	-
May-13	1	<1.0	<1.0	<4.0	<1.0	NR	<0.50	0.0	-	-	-	-
Dec-13	1	<1.0	<1.0	<4.0	<1.0	NR	<0.50	0.3	-	-	-	-
Dec-14	1	<1.0	<1.0	<4.0	<1.0	NR	<0.50	0.3	-	-	-	-
May-15	1	<1.0	0.3	<4.0	<1.0	NR	<0.50	0.3	-	100.0	-	-
Nov-15	1	<0.40	<0.30	<1.0	<0.70	<2.0	<0.30	0.0	-	-	-	-
May-16	1	<0.40	<0.30	<1.0	<0.70	<2.0	<0.30	0.0	-	-	-	-
Nov-16	1	<0.40	0.3	<1.0	<0.70	<2.0	<0.30	0.3	-	100.0	-	-
May-17	1	<0.40	<0.30	<1.0	<0.70	<2.0	<0.30	0.0[16]	-	-	-	-
Nov-17	1	<0.60	<0.70	<1.0	<0.60	<2.0	<0.50	0.0	-	-	-	-
May-18	1	<0.60	<0.70	<1.0	<0.60	<2.0	<0.50	0.0	-	-	-	-
Nov-18	1	<0.60	<0.70	<1.0	<0.60	<2.0	<0.50	0.0	-	-	-	-
May-19	1	<0.60	<0.70	<1.0	<0.60	<2.0	<0.50	0.0[16]	-	-	-	-

Notes:
1. Values for 11/92 are the average of measurements for 7/92 and 5/93.
2 2/97 and 12/97: No measurement, high flow in Gillie Creek.
3. 5/99: No measurement, area flooded by Beaver Dam backwater.
4. 8/99: No measurement, no water in Gillie Creek.
5. Reporting Limit = Dilution Factor x MDL.
6. Shaded Area - Reported result exceeds cleanup goal.
7. MDL for February 1999 is 1.5 for both DCA and DCE, due to change in laboratories.
8. Acetone, a common laboratory contaminant, was detected in 2/00 at 170 ug/l, 10/10 at 7.8 ug/l, 5/17 at 8.85 ug/l, and 5/19 at 11.0 ug/l.
9. Toluene reported at 0.3J ug/l in 4/03, 4/11, and 4/12.
10. MTBE reported at 2.7 ug/l in 4/03, 1.4 ug/l in 4/05, 0.4J ug/l in 10/06, 2.9 ug/l in 4/07, 1.2 ug/l in 5/08, 0.4J ug/l in 5/09, and 0.2J ug/l in 4/10.
11. Naphthalene reported at 1.6 ug/l in 10/05.
12. Chloroform reported at 0.6J ug/l in 11/08 and 0.3J ug/l in 11/12.
13. 1,4-D has an EPA Risk Level of 6.1 ug/l and VC has a MCL of 2 ug/l. 1,4-D or 1,4-D SIM was included in total VOCs in this reporting period.
14. NR = Not Reported
15. 1,4-D was analyzed using the SIM Method.
16. Acetone not included in Total VOCs for May 2017 and May 2019 sampling events.

Completed By: David Young Date: June 11, 2019 Checked By: Forrest Hayward Date: June 13, 2019

Table 7
VOC Concentrations at SW15
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Date		Concentration, ug/l							Percent (%) of Total VOCs Detected			
		DCA	DCE	MEC	TCA	1,4-D [12]	VC	Total VOCS	DCA	DCE	MEC	TCA
	Goal	4	7	5	200	6.1[10]	2[10]	-	-	-	-	-
	Dilution Factor											
Mar-89	1	<1.0	<1.0	<5.0	5	NR	NR	5.0	-	-	-	100
Nov-90	1	<1.0	10	<5.0	9.9	NR	NR	19.9	-	50.3	-	49.7
Apr-91	1	<1.0	9.7	<5.0	11	NR	NR	20.7	-	46.9	-	53.1
Aug-91	1	<1.0	4.9	<5.0	5.5	NR	NR	10.4	-	47.1	-	52.9
Oct-91	1	<1.0	10	<5.0	11	NR	NR	21.0	-	47.6	-	52.4
Jan-92	1	<1.0	23	<5.0	19	NR	NR	42.0	-	54.8	-	45.2
May-92	1	<1.0	17	<5.0	12	NR	NR	29.0	-	58.6	-	41.4
Jul-92	1	<1.0	8.6	<5.0	11	NR	NR	19.6	-	43.9	-	56.1
Nov-92	1	<1.0	8.8	<5.0	8.5	NR	NR	17.3	-	50.9	-	49.1
May-93	1	<1.0	9	<5.0	6	NR	NR	15.0	-	60.0	-	40.0
Sep-93	1	<1.0	1	<5.0	2	NR	NR	3.0	-	33.3	-	66.7
Dec-93	1	<1.0	9	<5.0	8	NR	NR	17.0	-	52.9	-	47.1
Apr-94	1	<1.0	6.4	<5.0	4.8	NR	NR	11.2	-	57.1	-	42.9
Feb-95	1	<1.0	12	<5.0	8	NR	NR	20.0	-	60.0	-	40.0
May-95	1	<1.0	5.9	<5.0	4.1	NR	NR	10.0	-	59.0	-	41.0
Aug-95	1	<1.0	<1.0	<5.0	<1.0	NR	NR	0.0	-	-	-	-
Nov-95	1	<1.0	10	<5.0	5.6	NR	NR	15.6	-	64.1	-	35.9
May-96	1	<1.0	6.2	<5.0	3	NR	NR	9.2	-	67.4	-	32.6
Aug-96	1	<1.0	3.5	<5.0	1.9	NR	NR	5.4	-	64.8	-	35.2
May-97	1	<1.0	1.4	<5.0	<1.0	NR	NR	1.4	-	100	-	-
Jul-97	1	<1.0	<1.0	<5.0	<1.0	NR	NR	0.0	-	-	-	-
Aug-97	1	<1.0	<1.0	<5.0	<1.0	NR	NR	0.0	-	-	-	-
Feb-98	1	<1.0	2.4	<5.0	<1.0	NR	NR	2.4	-	100	-	-
Jun-98	1	<1.0	1.3	<5.0	<1.0	NR	NR	1.3	-	100	-	-
Sep-98	1	<1.0	<1.0	<5.0	<1.0	NR	NR	0.0	-	-	-	-
Nov-98	1	<1.0	<1.0	<5.0	<1.0	NR	NR	0.0	-	-	-	-
Feb-99	1	<1.5	1.9	<5.0	<1.0	NR	NR	1.9	-	100	-	-
May-99	1	<1.5	<1.5	<5.0	<1.0	NR	NR	0.0	-	-	-	-
Aug-99	1	<1.5	<1.5	<5.0	<1.0	NR	NR	0.0	-	-	-	-
Nov-99	1	<1.0	<1.0	<1.0	<1.0	NR	NR	0.0	-	-	-	-
Feb-00	1	<1.0	<1.0	<1.0	<1.0	NR	NR	46.0	-	-	-	-
May-00	1	<10	<10	<20	<10	NR	NR	0.0	-	-	-	-
Nov-00	1	<5	7	<5	11	NR	NR	18.0	-	64.8	-	35.2
May-01	1	<5	<5	<5	<5	NR	NR	0.0	-	-	-	-
Nov-01	1	<4	<4	<10	<4	NR	NR	0.0	-	-	-	-
Apr-02	1	0.1	<1.0	<1.0	<1.0	NR	NR	0.0	100	-	-	-
Nov-02	1	<1.0	<1.0	<1.0	<1.0	NR	NR	0.0	-	-	-	-
Apr-03	1	<1.0	<1.0	<1.0	<1.0	NR	NR	0.4	-	-	-	-
Oct-03	1	<1.0	0.3	<1.0	0.2	NR	NR	0.5	-	60.0	-	40.0
Apr-04	1	<1.0	0.6	<1.0	<1.0	NR	NR	1.3	-	46.2	-	-
Oct-04	1	<1.0	<1.0	<1.0	<1.0	NR	NR	0.0	-	-	-	-
Apr-05	1	<1.0	<1.0	<1.0	<1.0	NR	NR	0.4	-	-	-	-
Oct-05	1	<1.0	<1.0	<1.0	<1.0	NR	NR	0.0	-	-	-	-
May-06	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
Oct-06	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.2	-	-	-	-
Apr-07	1	<1.0	0.2	<4.0	<1.0	NR	NR	1.1	-	18.2	-	-
Oct-07	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
May-08	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.3	-	-	-	-
Nov-08	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
May-09	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.3	-	-	-	-
Oct-09	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
Apr-10	1	<1.0	<1.0	<4.0	<1.0	NR	NR	3.1	-	-	-	-
Oct-10	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
Apr-11	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
Nov-11	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
Apr-12	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
Nov-12	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
May-13	1	<1.0	<1.0	<4.0	<1.0	NR	<0.50	0.0	-	-	-	-
Dec-13	1	<1.0	<1.0	<4.0	<1.0	NR	<0.50	0.0	-	-	-	-
Dec-14	1	<1.0	<1.0	<4.0	<1.0	NR	<0.50	0.0	-	-	-	-
May-15	1	<1.0	<1.0	<4.0	<1.0	NR	<0.50	0.4	-	-	-	-
Nov-15	1	<0.40	<0.30	<1.0	<0.70	<2.0	<0.30	0.0	-	-	-	-
May-16	1	<0.40	<0.30	<1.0	<0.70	<2.0	<0.30	0.0	-	-	-	-
Nov-16	1	<0.40	<0.30	<1.0	<0.70	<2.0	<0.30	0.0	-	-	-	-
May-17	1	<0.40	<0.30	<1.0	<0.70	<2.0	<0.30	0.0[13]	-	-	-	-
Nov-17	1	<0.60	<0.70	<1.0	<0.60	<2.0	<0.50	0.0	-	-	-	-
May-18	1	<0.60	<0.70	<1.0	<0.60	<2.0	<0.50	0.0	-	-	-	-
Nov-18	1	<0.60	<0.70	<1.0	<0.60	<2.0	<0.50	0.0[13]	-	-	-	-
May-19	1	<0.60	<0.70	<1.0	<0.60	<2.0	<0.50	0.0	-	-	-	-

Notes:
1. Values for 11/92 are the average of measurements for 7/92 and 5/93.
2. 11/96: No measurement, access prevented because of train on track.
3. 2/97 and 12/97: No measurement, high flow in Gillie Creek.
4. Shaded Area - Reported result exceeds cleanup goal.
5. When sample dilution is required to perform an analysis, the reporting limit becomes the product of the dilution factor and the detection limit, reported by the laboratory with a maximum of two significant digits.
6. MDL for February 1999 and May 1999 is 1.5 for both DCA and DCE, due to change in laboratories.
7. Acetone, a common laboratory contaminant, was detected in February 2000, May 2017, and November 2018 at 46 ug/l, 8.16 ug/l, and 8.39 ug/l, respectively.
8. MTBE reported at 0.4J ug/l in 4/03, 0.7J ug/l in 4/04, 0.4J ug/l in 4/05, 0.2J ug/l in 10/06, 0.9J ug/l in 4/07, 0.3J ug/l in 5/08, 0.3J ug/l in 5/09, 2.7 ug/l in 4/10.
9. Chloroform reported at 0.3J ug/l in November 2008 and 0.4J ug/l in April 2010.
10. 1,4-D has an EPA Risk Level of 6.1 ug/l and VC has a MCL of 2 ug/l. 1,4-D or 1,4-D SIM was included in total VOCs in this reporting period.
11. NR = Not Reported
12. 1,4-D was analyzed using the SIM Method.
13. Acetone not included in Total VOCs for May 2017 and November 208 sampling events.

Completed By: David Young Date: June 11, 2019 Checked By: Forrest Hayward Date: June 13, 2019

Table 8
VOC Concentrations at SW67 (Modified)
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Date	Goal	Concentration, ug/l							Percent (%) of Total VOCs Detected			
		DCA	DCE	MEC	TCA	1,4-D (6)	VC	Total VOCS	DCA	DCE	MEC	TCA
		4	7	5	200	6.1(4)	2(4)	-	-	-	-	-
	Dilution Factor											
May-00	1	<10	<10	<20	<10	NR	NR	0	-	-	-	-
Nov-00	1	<5	<5	<5	<5	NR	NR	0	-	-	-	-
May-01	1	<5	<5	<5	<5	NR	NR	0	-	-	-	-
Nov-02	1	0.3	<1.0	<1.0	8.1	NR	NR	8.4	3.7	-	-	96.4
Apr-03	1	<1.0	0.2	<1.0	0.3	NR	NR	0.8	-	66.7	-	37.5
Oct-03	1	<1.0	<1.0	<1.0	<1.0	NR	NR	0	-	-	-	-
Apr-04	1	<1.0	<1.0	<1.0	<1.0	NR	NR	0	-	-	-	-
Oct-05	1	<1.0	<1.0	<1.0	12	NR	NR	17.9	-	-	-	67.0
Oct-06	1	<1.0	<1.0	<4.0	0.6	NR	NR	0.6	-	-	-	100
Apr-07	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.6	-	-	-	-
May-08	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
Apr-10	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
Oct-10	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
Apr-11	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
Nov-11	1	<1.0	<1.0	<4.0	<1.0	NR	NR	0.0	-	-	-	-
May-13	1	<1.0	<1.0	<4.0	<1.0	NR	<0.50	0.0	-	-	-	-
Dec-13	1	<1.0	<1.0	<4.0	<1.0	NR	<0.50	0.0	-	-	-	-
Dec-14	1	<1.0	<1.0	<4.0	<1.0	NR	<0.50	0.0	-	-	-	-
Nov-15	1	<1.0	<1.0	<4.0	<1.0	<2.0	<0.50	0.0	-	-	-	-
May-16	1	<1.0	<1.0	<4.0	<1.0	<2.0	<0.50	0.0	-	-	-	-
Nov-16	1	<1.0	0.45	<4.0	<1.0	<2.0	<0.50	0.45	-	100.0	-	-
May-17	1	<1.0	<1.0	<4.0	<1.0	<2.0	<0.50	0.0	-	-	-	-
Nov-17	1	<0.60	<0.70	<2.0	<0.60	<2.0	<0.50	0.0	-	-	-	-
May-18	1	<0.60	<0.70	<1.0	<0.60	<2.0	<0.50	0.0	-	-	-	-
Nov-18	1	<0.60	<0.70	<1.0	<0.60	<2.0	<0.50	0.0[8]	-	-	-	-
May-19	1	<0.60	<0.70	<1.0	<0.60	<2.0	<0.50	0.0	-	-	-	-

Notes:
1. Reporting Limit = Dilution Factor x MDL.
2. Trans-1,3-dichloro-1-propene reported at 0.3J ug/l in 4/03.
3. Trichlorofluoromethane reported at 5.9 ug/l in 10/05 and 0.6J ug/l in 4/07.
4. Acetone, a common laboratory contaminant, was detected in 11/18 at 10.4 ug/l.
5. 1,4-D has an EPA Risk Level of 6.1 ug/l and VC has a MCL of 2 ug/l. 1,4-D or 1,4-D SIM was included in total VOCs in this reporting period.
6. NR = Not Reported
7. 1,4-D was analyzed using the SIM Method.
8. Acetone not included in Total VOCs for November 2018 sampling event.

Completed By: David Young Date: June 11, 2019 Checked By: Forrest Hayward Date: June 13, 2019

Table 9
VOC Concentrations at MW10
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Date		Concentration, ug/l							Percent (%) of Total VOCs Detected			
		DCA	DCE	MEC	TCA	1,4-D [10]	VC	Total VOCS	DCA	DCE	MEC	TCA
	Goal	4	7	5	200	6.1[8]	2[8]	-	-	-	-	-
	Dilution Factor											
Nov-87		ND	25000	180000	14000	NR	NR	345000	-	7.2	52.2	4.1
Jan-88		ND	ND	110000	210000	NR	NR	320000	-	-	34.4	65.6
Jul-88	N/A	ND	14000	422000	448000	NR	NR	884000	-	1.6	47.7	50.7
Sep-88	N/A	ND	21000	460000	380000	NR	NR	861000	-	2.4	53.4	44.1
Dec-88	N/A	2800	15000	360000	385000	NR	NR	762800	0.4	2.0	47.2	50.5
Mar-89	N/A	ND	29000	660000	540000	NR	NR	1229000	-	2.4	53.7	43.9
Apr-91	N/A	2700	20000	200000	210000	NR	NR	432700	0.6	4.6	46.2	48.5
Aug-91	N/A	ND	17000	180000	180000	NR	NR	377000	-	4.5	47.7	47.7
Oct-91	N/A	ND	22000	160000	180000	NR	NR	362000	-	6.1	44.2	49.7
Jan-92	N/A	2400	37000	180000	180000	NR	NR	399400	0.6	9.3	45.1	45.1
May-92	N/A	2500	17000	150000	230000	NR	NR	399500	0.6	4.3	37.5	57.6
Jul-92	N/A	ND	14000	130000	220000	NR	NR	364000	-	3.8	35.7	60.4
Nov-92	N/A	3700	200000	21000	210000	NR	NR	434700	0.9	46.0	4.8	48.3
May-93	N/A	ND	6400	17000	270000	NR	NR	293400	-	2.2	5.8	92.0
Sep-93	N/A	2800	13000	130000	180000	NR	NR	325800	0.9	4.0	39.9	55.2
Dec-93	N/A	ND	12000	82000	130000	NR	NR	224000	-	5.4	36.6	58.0
Feb-95	2500	<2500	18000	80000	84000	NR	NR	182000	-	9.9	44.0	46.2
May-95	2500	<2500	7900	18000	77000	NR	NR	102900	-	7.7	17.5	74.8
Aug-95	2500	<2500	6900	26000	54000	NR	NR	86900	-	7.9	29.9	62.1
Nov-95	2500	<2500	11000	28000	58000	NR	NR	97000	-	11.3	28.9	59.8
May-96	1000	<1000	6000	8600	35000	NR	NR	49600	-	12.1	17.3	70.6
Aug-96	1000	<1000	8400	16000	42000	NR	NR	66400	-	12.7	24.1	63.3
Nov-96	250	490	6200	6100	25000	NR	NR	37790	1.3	16.4	16.1	66.2
Feb-97	250	<250	4700	3300	18000	NR	NR	26000	-	18.1	12.7	69.2
May-97	200	<200	3800	2000	14000	NR	NR	19800	-	19.2	10.1	70.7
Aug-97	250	<250	6500	4000	24000	NR	NR	34500	-	18.8	11.6	69.6
Dec-97	500	<500	6300	3300	27000	NR	NR	36600	-	17.2	9.0	73.8
Feb-98	500	<500	8600	2700	36000	NR	NR	47300	-	18.2	5.7	76.1
Jun-98	500	<500	8000	2700	29000	NR	NR	39700	-	20.2	6.8	73.0
Aug-98	N/A	190	5800	2400	16000	NR	NR	24390	0.8	23.8	9.8	65.6
Sep-98	250	<250	6200	2200	20000	NR	NR	28400	-	21.8	7.7	70.4
Nov-98	250	<250	4400	<1250	12000	NR	NR	16400	-	26.8	-	73.2
Feb-99	200	350	6500	<1000	17000	NR	NR	23850	1.5	27.3	-	71.3
May-99	200	900	6200	5100	30000	NR	NR	42200	2.1	14.7	12.1	71.1
Aug-99	100	310	7200	<500	12000	NR	NR	19510	1.6	36.9	-	61.5
Nov-99	10	760	6630	450	18900	NR	NR	26740	2.8	24.8	1.7	70.7
Feb-00	200	580	6300	1380	19500	NR	NR	27760	2.1	22.7	5.0	70.2
May-00	2000	<20000	7050	<40000	16400	NR	NR	23450	-	30.1	-	69.9
Nov-00	1000	<5000	14300	7140	33400	NR	NR	54886	-	26.1	13.0	60.9
May-01	20	120	2680	1880	4000	NR	NR	8680	1.4	30.9	21.7	46.1
Nov-01	200	<800	3400	<2000	8080	NR	NR	11480	-	29.6	-	70.4
Apr-02	500	<500	2900	550	11400	NR	NR	14850	-	19.5	3.7	76.8
Nov-02	200	88	1900	330	9000	NR	NR	11318	0.8	16.8	2.9	79.5
Apr-03	1	520	1600	220	8000	NR	NR	10355	5.0	15.5	2.1	77.3
Oct-03	1	560	3600	410	15000	NR	NR	19583	2.9	18.4	2.1	76.6
Apr-04	1	120	700	62	2400	NR	NR	3288	3.7	21.3	1.9	73.0
Oct-04	1	160	820	14	2000	NR	NR	3002	5.3	27.3	0.5	66.6
Apr-05	1	60	370	6.0	1000	NR	NR	1439	4.2	25.7	0.4	69.5
Oct-05	1	130	500	2.7	1400	NR	NR	2040	6.4	24.5	0.1	68.6
May-06	1	260	370	4.6	1900	NR	NR	2543	10.2	14.5	0.2	74.7
Oct-06	1	78	370	3.9	1000	NR	NR	1457	5.4	25.4	0.3	68.6
Apr-07	1	93.9	569	2.2	1150	NR	NR	1821.9	5.2	31.2	0.1	63.1
Oct-07	1	4770	4870	14600	46700	NR	NR	71041.4	6.7	6.9	20.6	65.7
May-08	1	1130	1840	926	19000	NR	NR	22917.8	4.9	8.0	4.0	82.9
Nov-08	1	197	1500	5.9	3470	NR	NR	5179.2	3.8	29.0	0.1	67.0
May-09	1	1020	2100	215	12700	NR	NR	16049.0	6.4	13.1	1.3	79.1
Oct-09	1	235	1670	11	2270	NR	NR	4210.1	5.6	39.7	0.3	53.9
Apr-10	1	140	1230	41.1	1100	NR	NR	2522.9	5.5	48.8	1.6	43.6
Oct-10	1	755	2360	62.8	7730	NR	NR	10919.2	6.9	21.6	0.6	70.8
Apr-11	1	126	1170	<4.0	1380	NR	NR	2683.5	4.7	43.6	-	51.4
Nov-11	1	131	1180	<4.0	984	NR	NR	2301.6	5.7	51.3	-	42.8
Apr-12	1	608	2450	3.4	6090	NR	NR	9157.6	6.6	26.8	0.04	66.5
Nov-12	1	177	2130	6.5	2840	NR	NR	5161.7	3.4	41.3	0.1	55.0
May-13	1 [7]	70.9	934	1.52	809	NR	1.16	1944.49	3.6	48.0	0.1	41.6
Dec-13	1 [7]	157	1510	4.68	826	NR	4.79	3128.38	5.0	48.3	0.1	26.4
Dec-14	1 [7]	45.7	371	<4.0	356	NR	1.06	936.96	4.9	39.6	-	38.0
May-15	1 [11]	816	2500	3.97	3860	NR	9.53	8534.49	9.6	29.3	0.0	45.2
Nov-15	1	26.8	127	<1.0	116	<40	0.79	270.59	9.9	46.9	-	42.9
May-16	1	217	0.54	58.5	1250	277	0.62	1841.93	11.8	0.0	3.2	67.9
Nov-16	1	144	625	1.26	399	346	16.7	1533.16	9.4	40.8	0.1	26.0
May-17	1	172	927	3.14	267	353	57.8	1780.92	9.7	52.1	0.2	15.0
Nov-17	1	106	252	29.3	139	238	126	898.54	11.8	28.0	3.3	15.5
May-18	1	253	1560	38.8	2690	560	56.8	5162.11	4.9	30.2	0.8	52.1
Nov-18	1	195	772	19.2	812	379	79.4	2259.04	8.6	34.2	0.8	35.9
May-19	1	609	1030	17.6	477	553	351	3048.41	20.0	33.8	0.6	15.6

Notes:
1. Shaded Area - Reported result exceeds cleanup goal.
2. ND - Not detected at reporting limit. Dilution factor and reporting limit not available prior to 2/95.
3. When sample dilution is required to perform an analysis, the reporting limit becomes the product of the dilution factor and the detection limit, reported by the laboratory with a maximum of two significant digits.
4. Written back up for Aug-98 is unavailable.
5. Chloroethane reported at 62.2 ug/l in October 2007, 8.6 ug/l in May 2008, <1.0 ug/l in November 2008, 4.2 ug/l in May 2009, <1.0 ug/l in October 2009 and April 2010, 1.7 ug/l in October 2010, and <1.0 ug/l since April 2011.
6. Vinyl Chloride reported at 2.0 ug/l in November 2011, 1.6 ug/l in April 2012, 1.4 ug/l in November 2012, 1.16 ug/l in May 2013
7. Dilution Factor for TCA and DCE are 10.
8. 1,4-D has an EPA Risk Level of 6.1 ug/l and VC has a MCL of 2 ug/l. 1,4-D or 1,4-D SIM was included in total VOCs in this reporting period.
9. NR = Not Reported
10. 1,4-D was analyzed using the SIM Method.
11. Dilution Factor for TCA, DCA and DCE are 50.

Completed By: David Young Date: June 11, 2019 Checked By: Forrest Hayward Date: June 13, 2019

Table 10
VOC Concentrations at MW17
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Date	Goal	Concentration, ug/l							Percent (%) of Total VOCs Detected			
		DCA	DCE	MEC	TCA	1,4-D [9]	VC	Total VOCS	DCA	DCE	MEC	TCA
		4	7	5	200	6.1 [7]	2 [7]	-	-	-	-	-
	Dilution Factor											
Nov-87	N/A	5290	850	ND	3750	NR	NR	9890	53.5	8.6	-	37.9
Jan-88	N/A	4300	650	ND	2200	NR	NR	7150	60.1	9.1	-	30.8
Jul-88	N/A	3800	825	43	2400	NR	NR	7068	53.8	11.7	0.6	34.0
Sep-88	N/A	3300	1000	86	2600	NR	NR	6986	47.2	14.3	1.2	37.2
Dec-88	N/A	5200	1300	130	4900	NR	NR	11530	45.1	11.3	1.1	42.5
Mar-89	N/A	6800	2000	ND	7000	NR	NR	15800	43.0	12.7	-	44.3
Jun-89	N/A	7600	1200	ND	8600	NR	NR	17400	43.7	6.9	-	49.4
Apr-91	N/A	2800	1700	ND	3700	NR	NR	8200	34.1	20.7	-	45.1
Aug-91	N/A	3500	2400	ND	2900	NR	NR	8800	39.8	27.3	-	33.0
Oct-91	N/A	3200	1900	ND	2700	NR	NR	7800	41.0	24.4	-	34.6
Jan-92	N/A	2200	2000	ND	2300	NR	NR	6500	33.8	30.8	-	35.4
May-92	N/A	3900	2700	ND	4300	NR	NR	10900	35.8	24.8	-	39.4
Jul-92	N/A	3100	2900	ND	3400	NR	NR	9400	33.0	30.9	-	36.2
Nov-92	N/A	2700	2300	ND	2500	NR	NR	7500	36.0	30.7	-	33.3
May-93	N/A	2900	1900	ND	3100	NR	NR	7900	36.7	24.1	-	39.2
Sep-93	N/A	2600	1800	ND	2800	NR	NR	7200	36.1	25.0	-	38.9
Dec-93	N/A	2200	1800	ND	2600	NR	NR	6600	33.3	27.3	-	39.4
Feb-95	25	1800	2300	<125	2500	NR	NR	6600	27.3	34.8	-	37.9
May-95	25	1900	1900	<125	2100	NR	NR	5900	32.2	32.2	-	35.6
Aug-95	25	2050	1650	<125	1850	NR	NR	5550	36.9	29.7	-	33.3
Nov-95	25	1900	2000	<125	1500	NR	NR	5400	35.2	37.0	-	27.8
May-96	25	1600	1300	<125	1500	NR	NR	4400	36.4	29.5	-	34.1
Aug-96	25	1900	2200	<125	2500	NR	NR	6600	28.8	33.3	-	37.9
Nov-96	12	1500	1400	<60	1600	NR	NR	4513	33.2	31.0	-	35.5
Feb-97	25	1000	1400	<125	1500	NR	NR	3900	25.6	35.9	-	38.5
May-97	25	900	1200	<125	1400	NR	NR	3500	25.7	34.3	-	40.0
Aug-97	25	1400	1500	<125	1400	NR	NR	4300	32.6	34.9	-	32.6
Dec-97	25	2200	1700	<125	1800	NR	NR	5700	38.6	29.8	-	31.6
Feb-98	25	820	1100	<125	1100	NR	NR	3020	27.2	36.4	-	36.4
Jun-98	10	410	650	<50	660	NR	NR	1720	23.8	37.8	-	38.4
Aug-98	N/A	1200	1100	<5.0	930	NR	NR	3257	37.2	34.1	-	28.8
Sep-98	25	1400	1300	<125	1200	NR	NR	3900	35.9	33.3	-	30.8
Nov-98	25	1500	1500	<125	1300	NR	NR	4300	34.9	34.9	-	30.2
Feb-99	20	1600	1400	<100	1200	NR	NR	4200	38.1	33.3	-	28.6
May-99	10	1700	1600	<50	1300	NR	NR	4654	36.5	34.4	-	27.9
Aug-99	20	1600	2100	<100	1400	NR	NR	5100	31.4	41.2	-	27.5
Nov-99	10	1680	1810	<10	1340	NR	NR	4861	34.6	37.2	-	27.6
Feb-00	10	1170	1250	<10	910	NR	NR	3391	34.5	36.9	-	26.8
May-00	1	970	1400	<20	950	NR	NR	3345	29.0	41.9	-	28.4
Nov-00	50	948	1830	<250	1010	NR	NR	3788	25.0	48.3	-	26.7
May-01	1	1210	1910	<5	935	NR	NR	4083	29.6	46.8	-	22.9
Nov-01	20	1560	1760	<200	1040	NR	NR	4360	35.8	40.4	-	23.9
Apr-02	100	830	1710	<100	670	NR	NR	3210	25.9	53.3	-	20.9
Nov-02	100	720	1400	<100	660	NR	NR	2812	25.6	49.8	-	23.5
Apr-03	1	790	990	<1.0	520	NR	NR	2319	34.1	42.7	-	22.4
Oct-03	1	960	1000	<1.0	920	NR	NR	2892	33.2	34.6	-	31.8
Apr-04	1	720	850	0.6	<1.0	NR	NR	1587	45.4	53.6	0.0	-
Oct-04	1	610	680	<1.0	1100	NR	NR	2407	25.3	28.2	-	45.7
Apr-05	1	550	490	0.6	1200	NR	NR	2254	24.4	21.7	0.0	53.2
Oct-05	1	320	430	<1.0	1000	NR	NR	1764	18.1	24.4	-	56.7
May-06	1	430	380	1.6	810	NR	NR	1634.5	26.3	23.2	0.1	49.6
Oct-06	1	320	240	<4.0	430	NR	NR	998.0	32.1	24.0	-	43.1
Apr-07	1	304	413	<4.0	402	NR	NR	1131.3	26.9	36.5	-	35.5
Oct-07	1	392	525	<4.0	673	NR	NR	1603.3	24.4	32.7	-	42.0
May-08	1	381	469	<4.0	1000	NR	NR	1870.1	20.4	25.1	-	53.5
Nov-08	1	380	417	<4.0	823	NR	NR	1653.2	23.0	25.2	-	49.8
May-09	1	462	264	<4.0	494	NR	NR	1387.4	33.3	19.0	-	35.6
Oct-09	1	349	267	1.7	226	NR	NR	1062.3	32.9	25.1	0.2	21.3
Apr-10	1	217	185	2.6	233	NR	NR	913.0	23.8	20.3	0.3	25.5
Oct-10	1	175	166	3.0	91.9	NR	NR	568.5	30.8	29.2	0.5	16.2
Apr-11	1	180	186	<4.0	86.6	NR	NR	497.2	36.2	37.4	-	17.4
Nov-11	1	138	110	1.7	52.4	NR	NR	354.5	38.9	31.0	0.5	14.8
Apr-12	1	121	153	<4.0	47.9	NR	NR	339.6	35.6	45.1	-	14.1
Nov-12	1	174	78.3	<4.0	29.3	NR	NR	301.3	57.7	26.0	-	9.7
May-13	1	146	50.4	<4.0	16.8	NR	5.33	274.96	53.1	18.3	-	6.1
Dec-13	1	120	111	<4.0	44.4	NR	6.45	292.53	41.0	37.9	-	15.2
Dec-14	1	192	234	<4.0	112	72.4	17.6	635.54	30.2	36.8	-	17.6
May-15	1	125	103	<4.0	33.4	NR	11.4	274.59	45.5	37.5	-	12.2
Nov-15	1	34.5	35.5	<1.0	17.7	14.9	3.91	106.51	32.4	33.3	-	16.6
May-16	1	134	132	2.16	51.8	96.4	18.9	437.93	30.6	30.1	0.5	11.8
Nov-16	1	142	130	<1.0	38.4	82.5	23.2	422.09	33.6	30.8	-	9.1
May-17	1	114	100	<1.0	31.2	95.7	19.5	374.47	30.4	26.7	-	8.3
Nov-17	1	194	229	<1.0	84.0	82.6	44.4	653.85	29.7	35.0	-	12.8
May-18	1	30.0	32.2	1.00	11.1	17.1	4.02	103.05	29.1	31.2	1.0	10.8
Nov-18	1	91.0	101	<1.0	22.9	67.3	27.7	324.95	28.0	31.1	-	7.0
May-19	1	133	154	<1.0	45.2	70.0	17.0	462.63	28.7	33.3	-	9.8

Notes:
1. Shaded Area - Reported result exceeds cleanup goal.
2. ND - Not detected at reporting limit. Dilution factor and reporting limit not available prior to 2/95.
3. When sample dilution is required to perform an analysis, the reporting limit becomes the product of the dilution factor and the detection limit, reported by the laboratory with a maximum of two significant digits.
4. Written back up for Aug-98 is unavailable.
5. Vinyl chloride reported at 13 ug/l in August 1998, 21 ug/l in May 2001, 32 ug/l in November 2002, 9.0 ug/l in April 2003, 6.9 ug/l in October 2003, 8.9 ug/l in April 2004, 10 ug/l in October 2004, 7.4 ug/l in April 2005, 10 ug/l in October 2005, 7.7 ug/l in May 2006, 4.9 ug/l in October 2006, 8.5 ug/l in April 2007, 8.3 ug/l in October 2007, 11.3 ug/l in May 2008, 16.2 ug/l in November 2008, 32.1 ug/l in May 2009, 27.1 ug/l in October 2009, 23.2 ug/l in April 2010, 10.3 ug/l in October 2010, 11.5 ug/l in April 2011, 12.3 ug/l in November 2011, 10.4 ug/l in April 2012, 10.4 ug/l in November 2012, and 5.33 ug/l in May 2013.
6. Chloroethane reported at 1.5 ug/l in April 2007, 2.4 ug/l in October 2007, 4.9 ug/l in May 2008, 13.8 ug/l in November 2008, 133 ug/l in May 2009, 188 ug/l in October 2009, 249 ug/l in April 2010, 120 ug/l in October 2010, 32.9 ug/l in April 2011, 38.7 ug/l in November 2011, 6.2 ug/l in April 2012, 8.3 ug/l in November 2012, and 2.91 ug/l in May 2013.
7. 1,4-D has an EPA Risk Level of 6.1 ug/l and VC has a MCL of 2 ug/l. 1,4-D or 1,4-D SIM was included in total VOCs in this reporting period.
8. NR = Not Reported
9. 1,4-D was analyzed using the SIM Method.

Completed By: David Young Date: June 11, 2019 Checked By: Forrest Hayward Date: June 13, 2019

Table 11
VOC Concentrations at MW28
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Date	Goal	Concentration, ug/l							Percent (%) of Total VOCs Detected			
		DCA	DCE	MEC	TCA	1,4-D [8]	VC	Total VOCS	DCA	DCE	MEC	TCA
		4	7	5	200	6.1[6]	2[6]	-	-	-	-	-
	Dilution Factor											
Sep-88	N/A	2800	20000	51000	70000	NR	NR	143800	1.9	13.9	35.5	48.7
Dec-88	N/A	960	10000	33000	48000	NR	NR	91960	1.0	10.9	35.9	52.2
Mar-89	N/A	ND	25000	55000	93000	NR	NR	173000	-	14.5	31.8	53.8
Jun-89	N/A	ND	16000	28000	58000	NR	NR	102000	-	15.7	27.5	56.9
Apr-91	N/A	ND	18000	23000	66000	NR	NR	107000	-	16.8	21.5	61.7
Aug-91	N/A	ND	9600	18000	54000	NR	NR	81600	-	11.8	22.1	66.2
Oct-91	N/A	2000	19000	26000	59000	NR	NR	106000	1.9	17.9	24.5	55.7
Jan-92	N/A	1100	18000	23500	47000	NR	NR	89600	1.2	20.1	26.2	52.5
May-92	N/A	ND	12000	21000	30000	NR	NR	63000	-	19.0	33.3	47.6
Jul-92	N/A	ND	12000	32000	37000	NR	NR	81000	-	14.8	39.5	45.7
Nov-92	N/A	ND	16000	11000	30000	NR	NR	57000	-	28.1	19.3	52.6
May-93	N/A	ND	9800	12000	26000	NR	NR	47800	-	20.5	25.1	54.4
Sep-93	N/A	ND	11000	13000	34000	NR	NR	58000	-	19.0	22.4	58.6
Dec-93	N/A	ND	11000	11000	36000	NR	NR	58000	-	19.0	19.0	62.1
Feb-95	250	1300	12000	6000	16000	NR	NR	35300	3.7	34.0	17.0	45.3
May-95	250	800	7800	4600	16000	NR	NR	29200	2.7	26.7	15.8	54.8
Aug-95	250	360	2300	<12500	3900	NR	NR	6560	5.5	35.1	-	59.5
Nov-95	50	300	3000	<250	4100	NR	NR	7400	4.1	40.5	-	55.4
May-96	100	390	5000	<500	9100	NR	NR	14490	2.7	34.5	-	62.8
Aug-96	100	310	3800	<500	6800	NR	NR	10910	2.8	34.8	-	62.3
Nov-96	100	350	4700	<500	8400	NR	NR	13450	2.6	34.9	-	62.5
Feb-97	100	320	3800	<500	9000	NR	NR	13120	2.4	29.0	-	68.6
May-97	100	300	4000	<500	9200	NR	NR	13500	2.2	29.6	-	68.1
Aug-97	100	270	3400	<500	7800	NR	NR	11470	2.4	29.6	-	68.0
Dec-97	25	70	1100	<125	1600	NR	NR	2770	2.5	39.7	-	57.8
Feb-98	125	240	3100	<625	8200	NR	NR	11540	2.1	26.9	-	71.1
Jun-98	100	150	2400	<500	6400	NR	NR	8950	1.7	26.8	-	71.5
Aug-98	N/A	150	9800	<5.0	17000	NR	NR	26950	0.6	36.4	-	63.1
Sep-98	50	180	2200	<250	4200	NR	NR	6580	2.7	33.4	-	63.8
Nov-98	1	2.3	31	<5.0	89	NR	NR	122	1.9	25.3	-	72.8
Feb-99	50	90	1500	<250	4800	NR	NR	6390	1.4	23.5	-	75.1
May-99	50	80	1200	<250	2700	NR	NR	3980	2.0	30.2	-	67.8
Aug-99	12.5	78	1100	<62	2000	NR	NR	3178	2.5	34.6	-	62.9
Nov-99	10	170	2090	<10	3900	NR	NR	6171	2.8	33.9	-	63.2
Feb-00	10	86	960	<10	1260	NR	NR	2306	3.7	41.6	-	54.6
May-00	1	62	860	<20	1900	NR	NR	2822	2.2	30.5	-	67.3
Nov-00	50	<250	1430	<250	1720	NR	NR	3161	-	45.2	-	54.4
May-01	1	78.6	1040	<5	1310	NR	NR	2429	3.2	42.8	-	53.9
Nov-01	10	<40	473	<100	935	NR	NR	1408	-	33.6	-	66.4
Apr-02	50	55	350	<50	695	NR	NR	1100	5.0	31.8	-	63.2
Nov-02	50	21	610	<50	2200	NR	NR	2831	0.7	21.5	-	77.7
Apr-03	1	25	550	<1.0	1400	NR	NR	1987	1.3	27.7	-	70.5
Oct-03	1	43	640	<1.0	2400	NR	NR	3094	1.4	20.7	-	77.6
Apr-04	1	32	220	<1.0	840	NR	NR	1102	2.9	20.0	-	76.2
Oct-04	1	31	250	<1.0	1600	NR	NR	1888	1.6	13.2	-	84.8
Apr-05	1	28	220	0.3	440	NR	NR	692	4.0	31.8	0.0	63.6
Oct-05	1	5.9	88	<1.0	85	NR	NR	180	3.3	48.9	-	47.3
May-06	1	28	170	2.3	450	NR	NR	653	4.3	26.1	0.4	69.0
Oct-06	1	20	230	<4.0	1200	NR	NR	1454	1.4	15.8	-	82.5
Apr-07	1	37.8	177	<4.0	379	NR	NR	595.4	6.3	29.7	-	63.7
Oct-07	1	5.2	65	<4.0	269	NR	NR	340.8	1.5	19.2	-	79.3
May-08	1	10.4	146	<4.0	340	NR	NR	500.5	2.1	29.4	-	68.4
May-09	1	10.6	208	<4.0	754	NR	NR	975.6	1.1	21.3	-	77.3
Oct-09	1	5.1	155	<4.0	615	NR	NR	778.1	0.7	19.9	-	79.0
Apr-10	1	3.9	154	<4.0	627	NR	NR	786.8	0.5	19.6	-	79.7
Oct-10	1	4.0	77.1	<4.0	298	NR	NR	381.1	1.0	20.2	-	78.2
Apr-11	1	11.1	73	<4.0	279	NR	NR	364.6	3.0	20.0	-	76.5
Nov-11	1	6.2	57.9	<4.0	230	NR	NR	294.5	2.1	19.7	-	78.1
Apr-12	1	7.6	25.2	<4.0	79.4	NR	NR	112.8	6.7	22.3	-	70.4
Nov-12	1	3.0	172	<4.0	537	NR	NR	716.8	0.4	24.0	-	74.9
May-13	1 [9]	5.70	228	<4.0	1100	NR	<0.50	1383.36	0.4	16.5	-	79.5
Dec-13	1	2.60	53.8	<4.0	134	NR	<0.50	192.96	1.3	27.9	-	69.4
Dec-14	1	2.97	22	<4.0	34	5.39	<0.50	68.87	4.3	31.9	-	49.4
May-15	1	2.83	77.9	<4.0	204	NR	<0.50	288.04	1.0	27.0	-	70.8
Nov-15	1	3.01	48.8	<1.0	114	5.83	<0.30	174.91	1.7	27.9	-	65.2
May-16	1	2.58	29.4	1.18	23.4	7.52	<0.30	74.00	3.5	39.7	1.6	31.6
Nov-16	1	3.22	32.0	<1.0	26	9.29	<0.30	80.81	4.0	39.6	-	32.2
May-17	1	2.68	21.2	<1.0	15.1	8.74	<0.30	58.84	4.6	36.0	-	25.7
Nov-17	1	4.08	12.7	<1.0	6.63	5.28	<0.50	35.22	11.6	36.1	-	18.8
May-18	1	7.67	10.1	<1.0	9.32	4.38	<0.50	37.34	20.5	27.0	-	25.0
Nov-18	1	7.36	7.66	<1.0	11.8	3.11	<0.50	33.73	21.8	22.7	-	35.0
May-19	1	9.06	5.99	<1.0	20.3	4.42	<0.50	50.95	17.8	11.8	-	39.8

Notes:
1. Shaded Area - Reported result exceeds cleanup goal.
2. ND - Not detected at reporting limit. Dilution factor and reporting limit not available prior to 2/95.
3. When sample dilution is required to perform an analysis, the reporting limit becomes the product of the dilution factor and the detection limit, reported by the laboratory with a maximum of two significant digits.
4. Written back up for Aug-98 is unavailable.
5. PCE reported at 15 ug/l in April 2002, 10 ug/l in April 2003, 8 ug/l in October 2003, 7.4 ug/l in April 2004, 4.7 ug/l in October 2004, 1.6 ug/l in April 2005, and <1.0 ug/l since April 2005.
6. 1,4-D has an EPA Risk Level of 6.1 ug/l and VC has a MCL of 2 ug/l. 1,4-D or 1,4-D SIM was included in total VOCs in this reporting period.
7. NR = Not Reported
8. 1,4-D was analyzed using the SIM Method.
9. Dilution Factor for TCA is 10.

Completed By: David Young Date: June 11, 2019 Checked By: Forrest Hayward Date: June 13, 2019

Table 12
Groundwater Contingency Results
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Monitoring Well	Date Sampled	1, 1, 1-TCA	1, 1-DCA	1, 1-DCE	MEC	1, 4-Dioxane	VC
GW Contingency Value		**4,000**	**80**	**150**	**100**	**92**	**40**
MW50	11/11/2015	2.05	1.54	19.2	<4.00	6.57	<0.50
	1/13/2016	1.22	1.03	12.3	<1.00	3.91	<0.30
	2/17/2016	<0.70	0.56 J	7.01	<1.00	2.71	<0.30
	3/23/2016	1.12	1.08	13.0	<1.00	5.00	<0.30
	4/19/2016	1.50	1.66	18.6	1.58 J	8.17	<0.30
	5/18/2016	0.83 J	0.92 J	10.3	<1.00	4.30	<0.30
	6/28/2016	<0.70	0.57 J	7.60	1.40 J	2.32	<0.30
	9/1/2016	3.62	3.15	48.2	<1.00	12.3	<0.30
	11/17/2016	3.77	3.35	48.9	<1.00	14.1	<0.30
	2/21/2017	2.88	2.32	29.5	<1.00	11.0	<0.30
	5/10/2017	3.26	2.48	31.1	<1.00	11.3	<0.30
	8/15/2017	10.5	6.59	95.6	<1.00	30.5	<0.30
	11/15/2017	5.08	3.39	41.5	<1.00	20.7	<0.30
	2/20/2018	4.43	3.40	42.3	<1.00	11.8	<0.30
	5/23/2018	1.95	1.45	19.5	<1.00	10.8	<0.30
	8/22/2018	3.66	3.06	44.0	<1.00	21.7	<0.50
	11/29/2018	1.40	1.41	19.0	<1.00	5.98	<0.50
	2/19/2019	0.70 J	0.76 J	8.82	<1.00	3.32	<0.50
	5/15/2019	0.73 J	0.75 J	10.2	<1.00	4.91	<0.50
MW51	11/11/2015	6.93	3.42	51.2	<4.00	22.8	<0.50
	1/13/2016	5.45	3.01	40.4	<1.00	14.6	<0.30
	2/17/2016	5.73	3.01	42.3	1.55 J	17.6	<0.30
	3/23/2016	4.54	2.58	35.1	<1.00	21.2	<0.30
	4/19/2016	6.53	3.52	54.8	1.17 J	17.3	<0.30
	5/18/2016	7.73	4.60	63.7	<1.00	28.2	<0.30
	6/28/2016	7.90	4.70	71.4	<1.00	25.9	<0.30
	9/1/2016	13.50	7.70	121	<1.00	38.7	<0.30
	10/19/2016	12.90	8.55	116	<1.00	Not Sampled	<0.30
	11/17/2016	14.2	10.1	128	<1.00	51.4	<0.30
	1/12/2017	10.9	10.7	120	<1.00	49.1	<0.30
	2/21/2017	14.6	13.4	134	<1.00	50.1	<0.30
	5/10/2017	13.3	10.1	128	<1.00	54.0	<0.30
	8/15/2017	12.7	12.0	137	<1.00	62.4	<0.30
	11/15/2017	10.7	9.80	111	<1.00	48.8	<0.30
	2/20/2018	11.6	13.7	131	<1.00	50.8	<0.30
	5/23/2018	10.4	11.0	116	<1.00	61.4	<0.30
	8/22/2018	9.25	9.80	99.8	<1.00	45.7	<0.50
	11/29/2018	8.93	10.7	104	<1.00	49.5	<0.50
	2/19/2019	17.5	17.5	145	<1.00	47.0	<0.50
	5/15/2019	14.0	11.0	113	<1.00	55.0	<0.50

Notes:
Concentrations reported in micrograms per liter (µg/L)
Bold - Indicated that results are above the SW Contingency Value.
J = Estimated value below the laboratory reporting limit
TCA = Trichloroethane, DCA = Dichloroethane, DCE = Dichloroethylene, MEC = Methylene Chloride, VC = Vinyl Chloride
The GW Contingency Value was back-calculated for MW50 and MW51 assuming that impact to the water-supply wells is no greater than the respective ROD Cleanup Goals, RSL, or MCL using dispersion and advection with no reaction mechanisms that would attenuate.

Updated By: David Young Date: June 11, 2019 Checked By: Forrest Hayward Date: June 13, 2019

Table 13
Surface Water Contingency Results
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Monitoring Well	Date Sampled	1, 1, 1-TCA	1, 1-DCA	1, 1-DCE	MEC	1, 4-Dioxane	VC
SW Contingency Value		**330,000**	**1,700**	**7,100**	**3,000**	**550**	**20**
	11/11/2015	<1.00	0.48 J	1.83	<4.00	<100	<0.50
	1/13/2016	<0.70	0.65 J	0.48 J	<1.00	<2.00	0.69
	2/17/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	3/23/2016	<0.70	2.47	5.76	<1.00	2.14	3.76
	4/19/2016	<0.70	4.43	13.0	1.51 J	3.49	6.14
	5/18/2016	<0.70	0.82 J	2.10	<1.00	<2.00	1.22
	6/28/2016	<0.70	<0.40	0.54 J	1.50 J	<2.00	0.33 J
	9/1/2016	<0.70	5.10	18.1	<1.00	5.23	5.96
	11/17/2016	<0.70	4.48	9.28	<1.00	3.38	6.37
MW53	2/21/2017	<0.70	3.20	6.42	<1.00	3.31	4.60
	5/10/2017	<0.70	1.95	2.14	<1.00	<2.00	3.24
	8/15/2017	<0.70	3.81	7.85	<1.00	<2.00	7.42
	11/15/2017	<0.70	1.79	3.34	<1.00	<2.00	3.89
	2/20/2018	<0.70	0.61 J	0.68 J	<1.00	<2.00	1.11
	5/23/2018	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	8/22/2018	<0.60	3.40	8.69	<1.00	3.30	9.65
	11/29/2018	<0.60	2.76	7.15	<1.00	3.14	7.42
	2/19/2019	<0.60	0.64 J	3.27	<1.00	<2.00	0.51
	5/15/2019	<0.60	1.36	2.62	<1.00	<2.00	4.12
	11/11/2015	<1.00	<1.00	0.53 J	<4.00	<100	<0.50
	1/13/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	2/17/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	3/23/2016	<0.70	<0.40	<0.30	1.22 J	<2.00	<0.30
	4/19/2016	<0.70	<0.40	0.60 J	1.86 J	<2.00	<0.30
	5/18/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	6/28/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	9/1/2016	<0.70	<0.40	1.06	<1.00	<2.00	<0.30
	11/17/2016	<0.70	<0.40	0.30 J	<1.00	<2.00	<0.30
MW54	2/21/2017	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	5/10/2017	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	8/15/2017	<0.70	<0.40	1.27	<1.00	<2.00	<0.30
	11/15/2017	<0.70	<0.40	0.44 J	<1.00	<2.00	<0.30
	2/20/2018	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	5/23/2018	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	8/22/2018	<0.60	<0.60	<0.70	<1.00	<2.00	<0.50
	11/29/2018	<0.60	<0.60	<0.70	<1.00	<2.00	<0.50
	2/19/2019	<0.60	<0.60	<0.70	<1.00	<2.00	<0.50
	5/15/2019	<0.60	<0.60	<0.70	<1.00	<2.00	<0.50

Table 13
Surface Water Contingency Results
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Monitoring Well	Date Sampled	1, 1, 1-TCA	1, 1-DCA	1, 1-DCE	MEC	1, 4-Dioxane	VC
SW Contingency Value		**330,000**	**1,700**	**7,100**	**3,000**	**550**	**20**
	11/11/2015	1.53	<1.00	<1.00	<4.00	<100	<0.50
	1/13/2016	0.71 J	<0.40	<0.30	<1.00	<2.00	<0.30
	2/17/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	3/23/2016	1.14	<0.40	<0.30	1.47 J	<2.00	<0.30
	4/19/2016	1.37	<0.40	<0.30	2.01 J	<2.00	<0.30
	5/18/2016	0.77 J	<0.40	<0.30	<1.00	<2.00	<0.30
	6/28/2016	1.34	<0.40	<0.30	<1.00	<2.00	<0.30
	9/1/2016	2.07	<0.40	<0.30	<1.00	<2.00	<0.30
	11/17/2016	1.24	<0.40	<0.30	<1.00	<2.00	<0.30
MW55	2/21/2017	1.50	<0.40	<0.30	<1.00	<2.00	<0.30
	5/10/2017	1.62	<0.40	<0.30	<1.00	<2.00	<0.30
	8/15/2017	1.00 J	<0.40	<0.30	<1.00	<2.00	<0.30
	11/15/2017	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	2/20/2018	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	5/23/2018	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	8/22/2018	<0.60	<0.60	<0.70	<1.00	<2.00	<0.50
	11/29/2018	<0.60	<0.60	<0.70	<1.00	<2.00	<0.50
	2/19/2019	<0.60	<0.60	<0.70	<1.00	<2.00	<0.50
	5/15/2019	0.79 J	<0.60	<0.70	<1.00	<2.00	<0.50
	11/11/2015	<1.00	<1.00	<1.00	<4.00	<100	<0.50
	1/13/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	2/17/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	3/23/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	4/19/2016	<0.70	<0.40	<0.30	1.31 J	<2.00	<0.30
	5/18/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	6/28/2016	No Sample (Sample Damaged)					
	9/1/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	11/17/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
MW56	2/21/2017	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	5/10/2017	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	8/15/2017	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	11/15/2017	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	2/20/2018	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	5/23/2018	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	8/22/2018	<0.60	<0.60	<0.70	<1.00	<2.00	<0.50
	11/29/2018	<0.60	<0.60	<0.70	<1.00	<2.00	<0.50
	2/19/2019	<0.60	<0.60	<0.70	<1.00	<2.00	<0.50
	5/15/2019	<0.60	<0.60	<0.70	<1.00	<2.00	<0.50

Table 13
Surface Water Contingency Results
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Monitoring Well	Date Sampled	1, 1, 1-TCA	1, 1-DCA	1, 1-DCE	MEC	1, 4-Dioxane	VC
SW Contingency Value		**330,000**	**1,700**	**7,100**	**3,000**	**550**	**20**
SW67	11/11/2015	<1.00	<1.00	<1.00	<4.00	<100	<0.50
	1/13/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	2/17/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	3/23/2016	<0.70	<0.40	<0.30	1.65 J	2.04	<0.30
	4/19/2016	<0.70	<0.40	<0.30	1.59 J	<2.00	<0.30
	5/18/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	6/28/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	9/1/2016	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	11/17/2016	<0.70	<0.40	0.45 J	<1.00	<2.00	<0.30
	2/21/2017	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	5/10/2017	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	8/15/2017	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	11/15/2017	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	2/20/2018	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	5/23/2018	<0.70	<0.40	<0.30	<1.00	<2.00	<0.30
	8/22/2018	<0.60	<0.60	<0.70	<1.00	<2.00	<0.50
	11/29/2018	<0.60	<0.60	<0.70	<1.00	<2.00	<0.50
	2/19/2019	<0.60	<0.60	<0.70	<1.00	<2.00	<0.50
	5/15/2019	<0.60	<0.60	<0.70	<1.00	<2.00	<0.50

Notes:
Concentrations reported in micrograms per liter (µg/L)
Bold - Indicated that results are above the SW Contingency Value.
J = Estimated value below the laboratory reporting limit
TCA = Trichloroethane, DCA = Dichloroethane, DCE = Dichloroethylene, MEC = Methylene Chloride, VC = Vinyl Chloride
SW Contingency Value is based on Virginia Department of Environmental Quality Surface Water Risk Calculations and Virginia Water Quality Standards - Surface Water/VRP Tier II Screening Levels.

Updated By: David Young Date: June 11, 2019 Checked By: Forrest Hayward Date: June 13, 2019

Table 14
Highest Total VOC Concentrations Over Time[1]
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Date	Highest Total VOCS (ug/L)	2nd Highest Total VOCS (ug/L)	% Decline from 1989 (based on 2nd Highest Total VOCs in 1989)	% Decline From Previous Row (based on 2nd highest total in previous row)[2]
1989	1,229,000	324,830	0	0
1995	194,100	182,000	44.0%	44.0%
1996	113,300	66,400	79.6%	63.5%
1997	89,200	59,490	81.7%	10.4%
1998	58,518	47,300	85.4%	20.5%
1999	42,200	35,270	89.1%	25.4%
2000	54,840	17,590	94.6%	50.1%
2001	46,430	15,424	95.3%	12.3%
2002	36,054	18,685	94.2%	-21.1%
2003	197,630	19,583	94.0%	-4.8%
2004	104,729	9,279	97.1%	52.6%
2005	71,632	3,796	98.8%	59.1%
2006	186,066	8,561	97.4%	-125.5%
2007	120,384	8,265	97.5%	3.5%
2008[3]	30,731	8,574	97.4%	-3.7%
2009	63,683	9,598	97.0%	-11.9%
2010	10,919	7,908	97.6%	17.6%
2011	5,477	3,919	98.8%	50.4%
2012	9,158	4,084	98.7%	-4.2%
2013	6,134	5,073	98.4%	-24.2%
2014	12,950	6,826	97.9%	-34.6%
2015	10,744	9,710	97.0%	-42.3%
2016	10,975	9,430	97.1%	2.9%
2017	10,703	7,436	97.7%	21.1%
2018	6,290	6,257	98.1%	15.9%
2019	7,719	6,319	98.1%	-1.0%

Completed By: David Young Date: June 21, 2019 Checked By: Ian Ros Date: June 27, 2019

Notes:

(1) The table only includes ROD Sampling Events.

(2) A negative decline suggests that Total VOC concentrations are higher than the previous year.

(3) 2008 contains the 2nd Highest (EW18) and 3rd Highest (MW12) Total VOCs due to an anomalous concentration (MW10) likely caused by site redevelopment.

Table 15
Contaminant Mass Removal Efficiency
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Period	Groundwater Volume (Mgal)	Total Vocs (kg) pumped	Removal Efficiency (kg/Mgal) - simple division	Cumulative kg/Mgal
2/95 to 2/97	17.9	764	43	0
2/97 to 2/99	16	398	25	68
2/99 to 2/01	15	192	13	80
2/01 to 2/03	22.9	315	14	94
2/03 to 2/05	28	164	6	100
2/05 to 2/07	30.7	129	4	104
2/07 to 2/09	17.3	132	8	112
2/09 to 2/11	29.6	94	3	115
2/11 to 2/13	28.4	121	4	119
2/13 to 5/15	39	104	3	122
5/15 to 5/17 (1)	8.9	20.5	2	124
5/17 to 5/19 (2)	2.54	20.7	8	132
Total	**256.24**	**2454.3**	**132**	**1171**

Completed By: David Young Date: June 21, 2019 Checked By: Ian Ros Date: June 27, 2019

Notes:

(1) During the reporting period from 5/15 to 5/17, a temporary system shutdown occurred from January 13, 2016 to December 13, 2016, according to the EPA approved 2016 Work Plan.

(2) During the reporting period from 5/17 to 5/19, only 2 extraction wells were operational according to the "Interim Next Steps" discussed in the 2017 Biennial Report.

Table 16
Relative Mass of the Contaminant Plume
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Year	Mass of Total VOCS (kg) (based on aquifer volume and concentration)	Reduction from 1989 plume
1989	4603	__
1995	2208	52%
1997	927	80%
1999	736	84%
2001	609	87%
2003	431	91%
2005	401	91%
2007	395	91%
2009	388	92%
2011	382	92%
2013	361	92%
2015*	433	91%
2017*	409	91%
2019*	409	91%

Completed By: David Young Date: June 21, 2019 Checked By: Ian Ros Date: June 27, 2019
Note: * Area for aquifer volume based on GIS tool and maybe different from historical estimates. Table has been updated for 2019 Biennial Report to account for new mass found during 2018 soil assessment.

Table 17
Groundwater Pumping System Flow Data
Biennial O&M Assessment Report
Former AT&T Richmond Works Facility
June 2017 to May 2019

Period	Starting Date	Ending Date	Total Flow for Period (gallons)	Average Flow for Period (gpm)
1st Bi-Annual	February 21, 1995	February 20, 1997	16,607,200	15.8
2nd Bi-Annual	February 21, 1997	February 20, 1999	15,983,800	15.2
3rd Bi-Annual	February 21, 1999	February 20, 2001	15,043,900	14.3
4th Bi-Annual	February 21, 2001	February 20, 2003	22,865,370	21.7
5th Bi-Annual	February 21, 2003	February 20, 2005	32,045,100	30.3
6th Bi-Annual	February 21, 2005	February 20, 2007	30,664,600	29.2
7th Bi-Annual	February 21, 2007	February 20, 2009	17,166,000	16.1
8th Bi-Annual	February 21, 2009	February 20, 2011	29,764,100	29.5
9th Bi-Annual	February 21, 2011	February 20, 2013	28,434,620	27.1
10th Biennial	Februrary 21, 2013	May 26, 2015	39,297,329	33.1
11th Biennial(1)	May 27, 2015	May 26, 2017	8,913,863	15.6
12th Biennial(2)	May 27, 2017	May 24, 2019	2,539,767	4.4
Total Flow/Average Flow Rate			**259,325,649**	**21**

Completed By: David Young Date: June 21, 2019 Checked By: Ian Ros Date: June 27, 2019

Notes:

(1) During the 11th Biennial reporting period, a temporary system shutdown occurred from January 13, 2016 to December 13, 2016, according to the EPA approved 2016 Work Plan.

(2) During the 12th Biennial reporting period, only 2 extraction wells were operational according to the "Interim Next Steps" discussed in the 2017 Biennial Report.

FIGURES

wood.

SITE:

LSI CORPORATION
Former Lucent Richmond Works
4500 Laburnum Ave., Richmond, VA

CLIENT:

BROADCOM INC.

Wood Environment & Infrastructure Solutions, Inc.
4021 Stirrup Creek Drive, Suite 100
Durham, NC 27703
(919) 381-9900

TITLE:

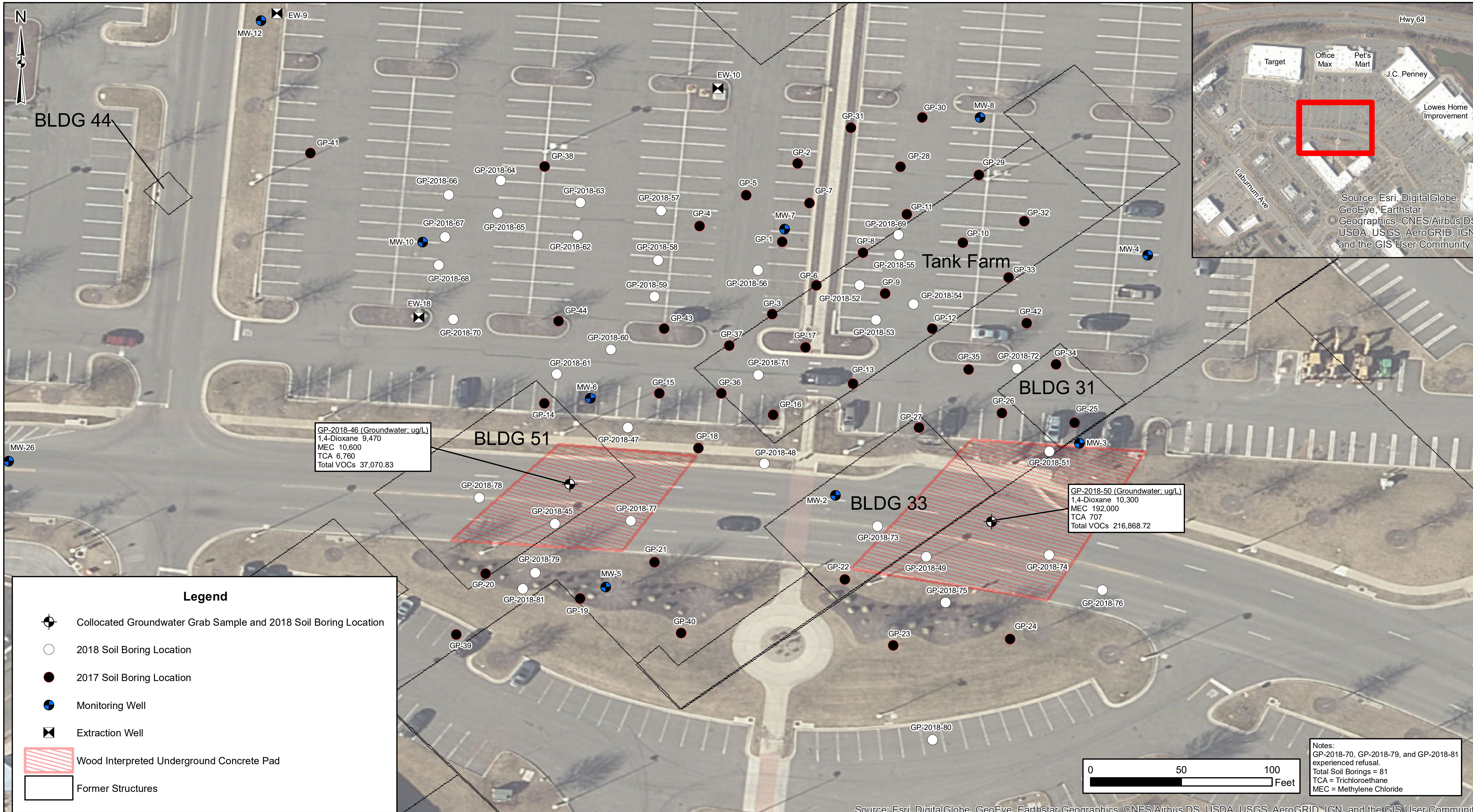
SITE MAP
WITH EXTRACTION AND
MONITORING WELL LOCATIONS

Figure:

1

SCALE: 1 " = 360 '	**DATE:** 06/19/2019	**PROJECT:** 6480199002
DRAWN BY: D. Young	**CHECKED BY:** S. Knox	

LOCATION: \\dhm-fs1\projects\Comm-Ind\Projects\Clients G to L\LSI Richmond\6480199002 Start Jan 2019\07_CADD and GIS



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4021 Stirrup Creek Drive, Suite 100
Durham, NC 27703
(919) 381-9900

CLIENT: **BROADCOM INC.**

DATE: 06/18/2019 **SCALE:** 1 " = 50 ' **PROJ.:** 6480181003

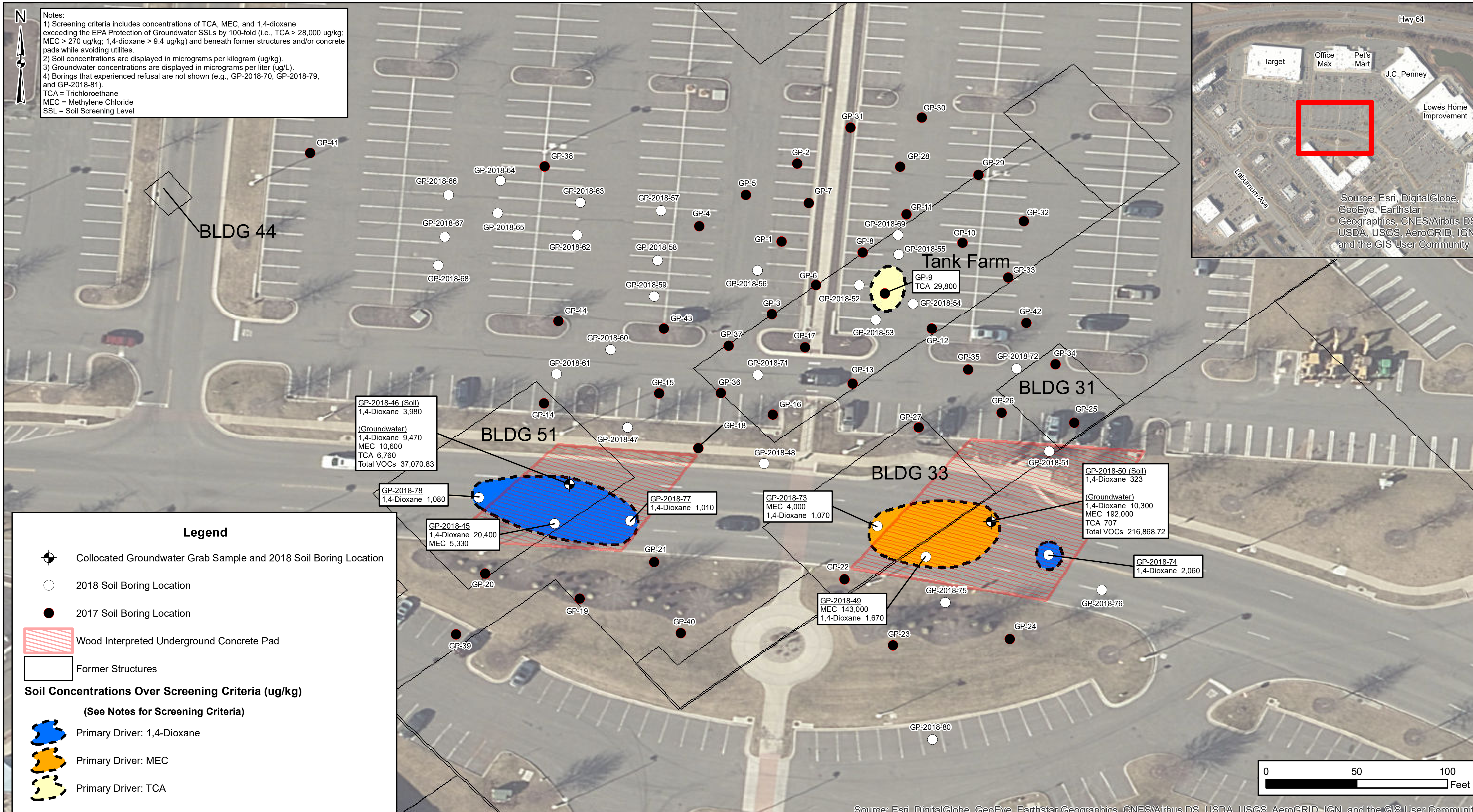
DR: D. Young **CHK:** S. Knox

LOCATION: \\dhm-fs1\projects\Comm-Ind\Projects\Clients G to L\LSI Richmond\6480181003 Start Jan 2018\07_CADD and GIS\Additional Soil Assessment

TITLE: **SOIL BORING & WELL LOCATIONS WITH GROUNDWATER GRAB SAMPLE RESULTS**

SITE: **LSI CORPORATION**
Former Lucent Richmond Works
4500 Laburnum Ave., Richmond, VA

Figure: 2



wood.	Wood Environment & Infrastructure Solutions Inc. 4021 Stirrup Creek Drive, Suite 100 Durham, NC 27703 (919) 381-9900	CLIENT: BROADCOM INC.	TITLE: ESTIMATED EXTENT OF VADOSE ZONE SOIL IMPACTS	Figure: 3
		DATE: 08/07/2019 SCALE: 1 " = 50 ' PROJ.: 6480181003	SITE: LSI CORPORATION Former Lucent Richmond Works 4500 Laburnum Ave., Richmond, VA	
		DR: D. Young CHK: S. Knox		
		LOCATION: \\dhm-fs1\projects\Comm-Ind\Projects\Clients G to L\LSI Richmond\6480181003 Start Jan 2018\07_CADD and GIS\Additional Soil Assessment		

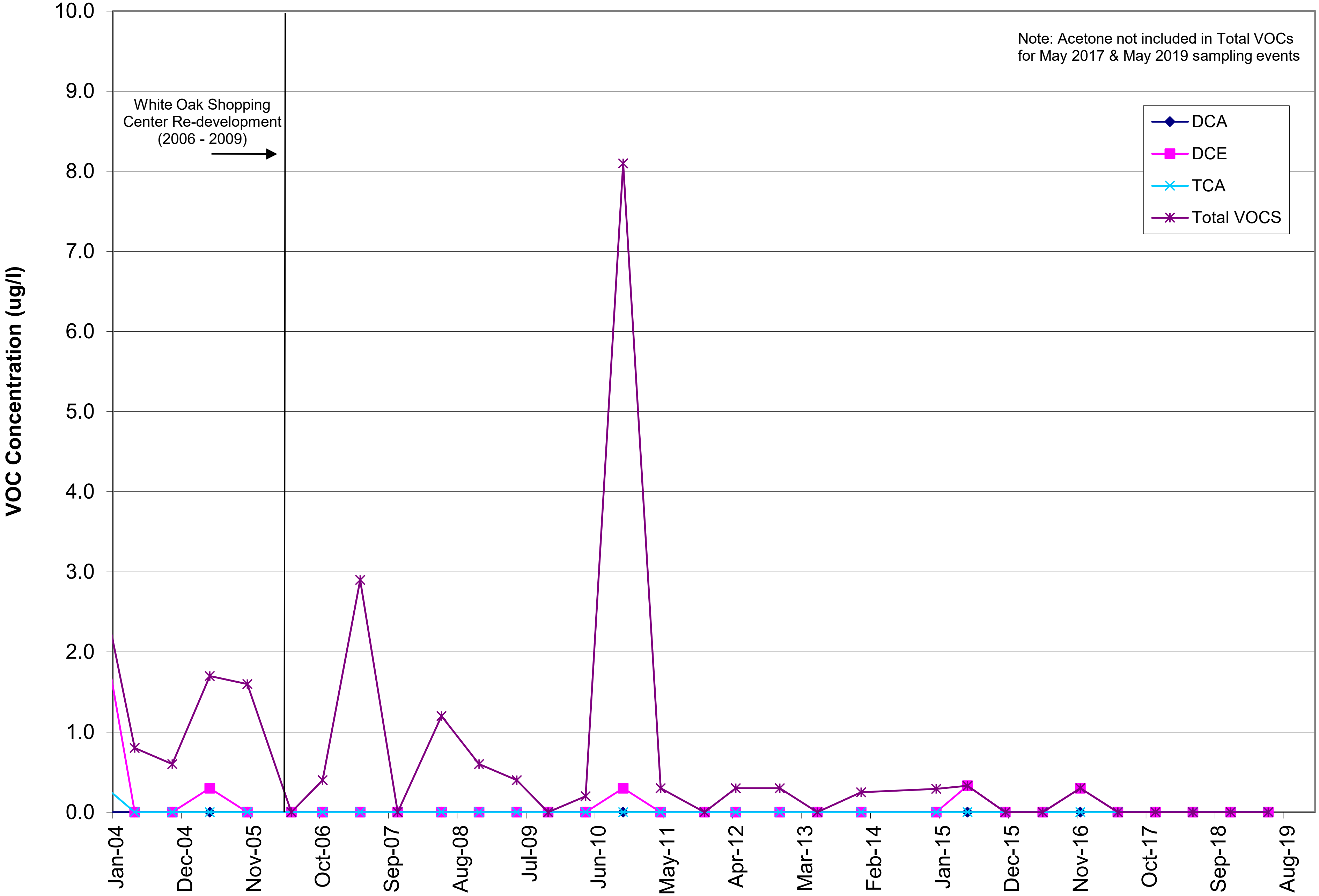


Figure 4
Total VOCs at SW21
Former AT&T Richmond Works Facility

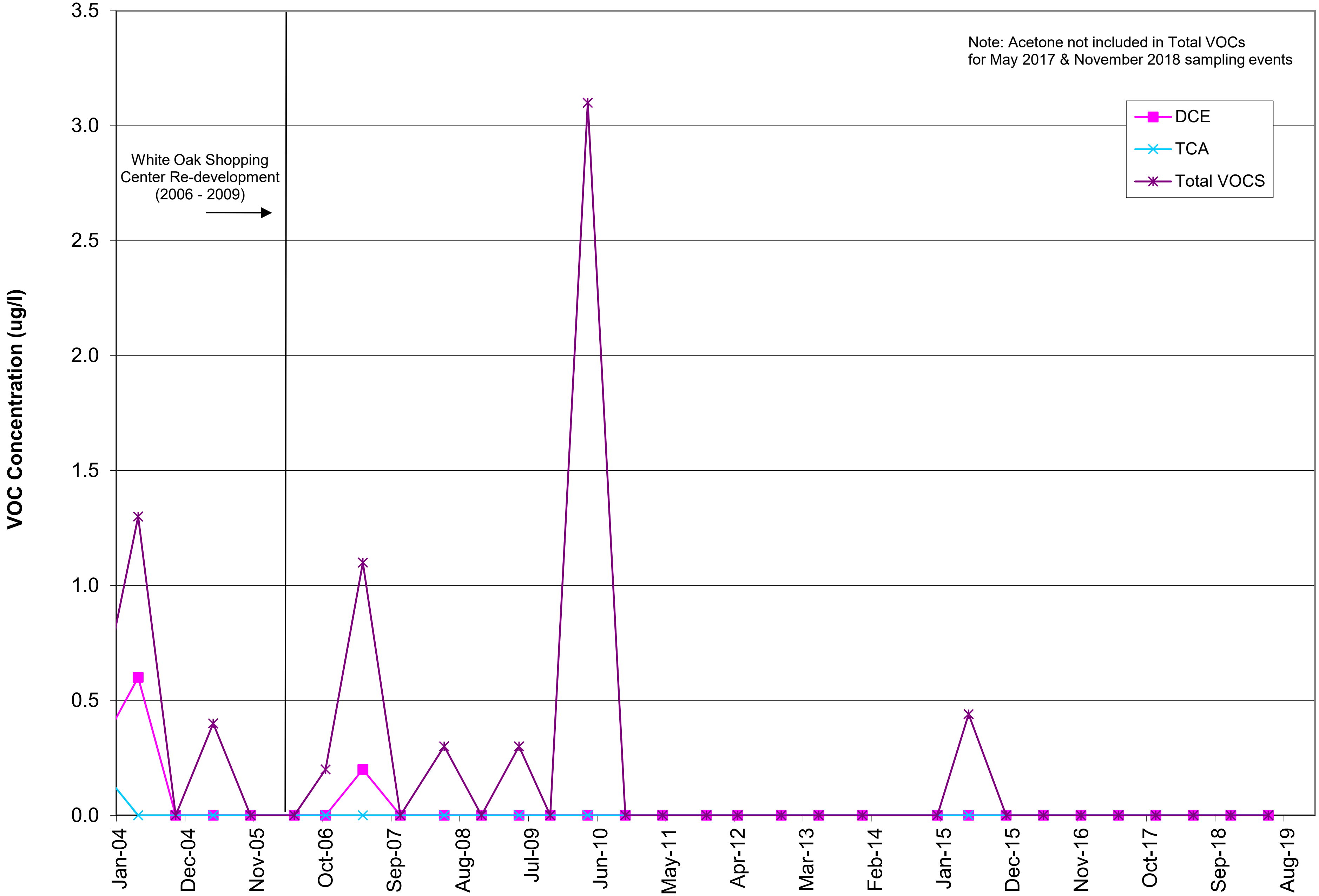


Figure 5
Total VOCs at SW15
Former AT&T Richmond Works Facility

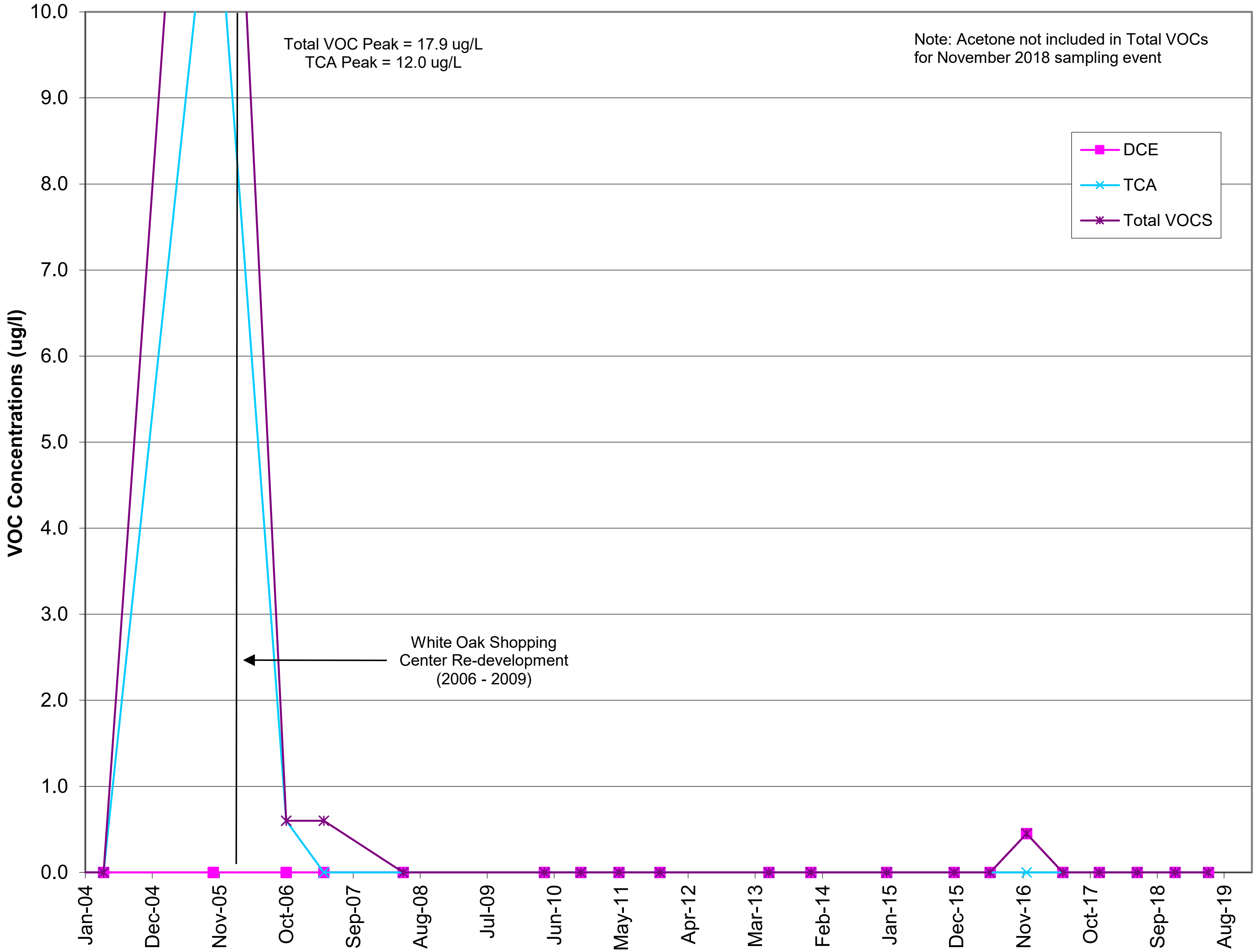


Figure 6
Total VOCs at SW67
Former AT&T Richmond Works Facility

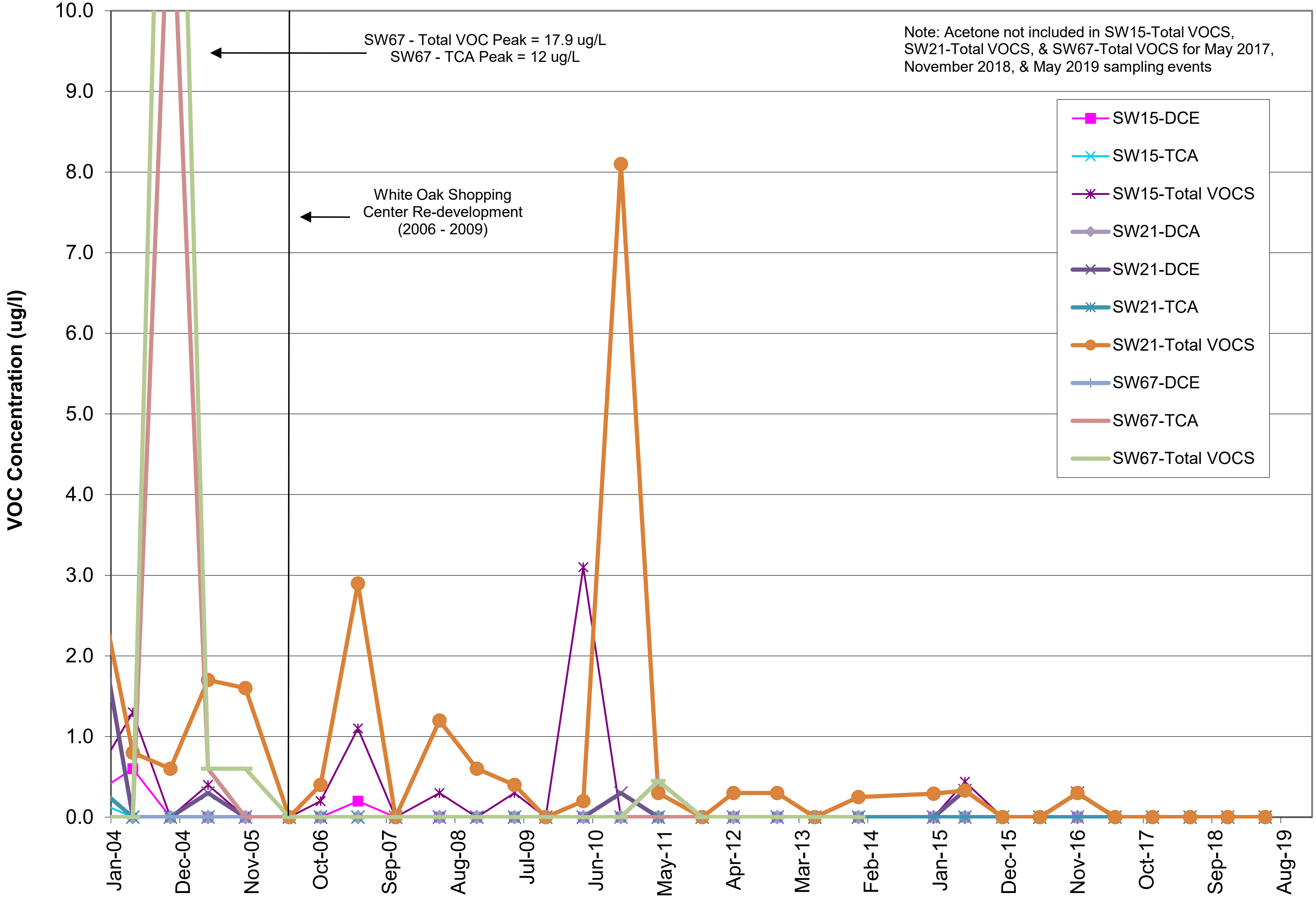


Figure 7
Total VOCs SW15, SW21, AND SW67 (Modified)
Former AT&T Richmond Works Facility

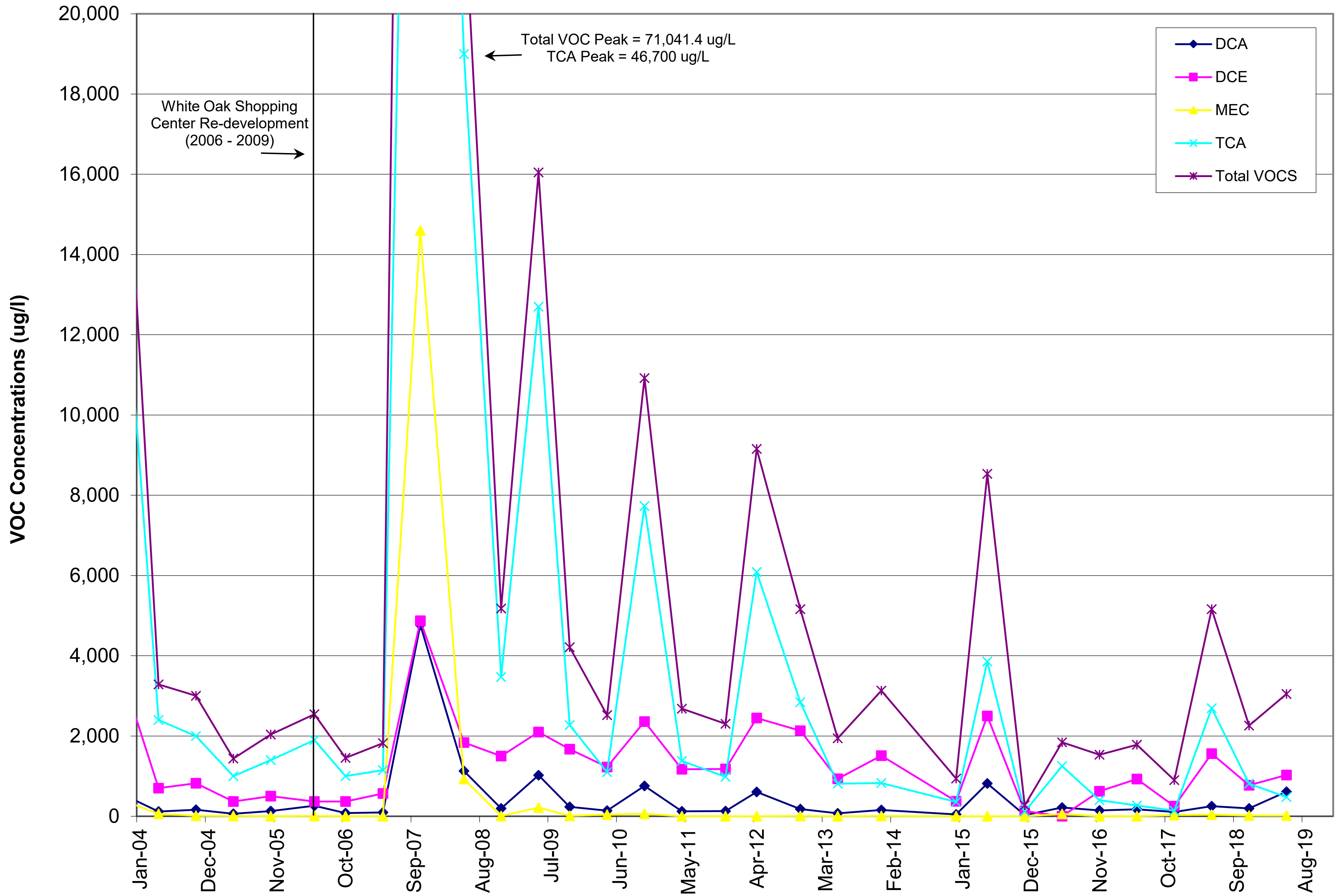


Figure 8
Total VOCs at MW10
Former AT&T Richmond Works Facility

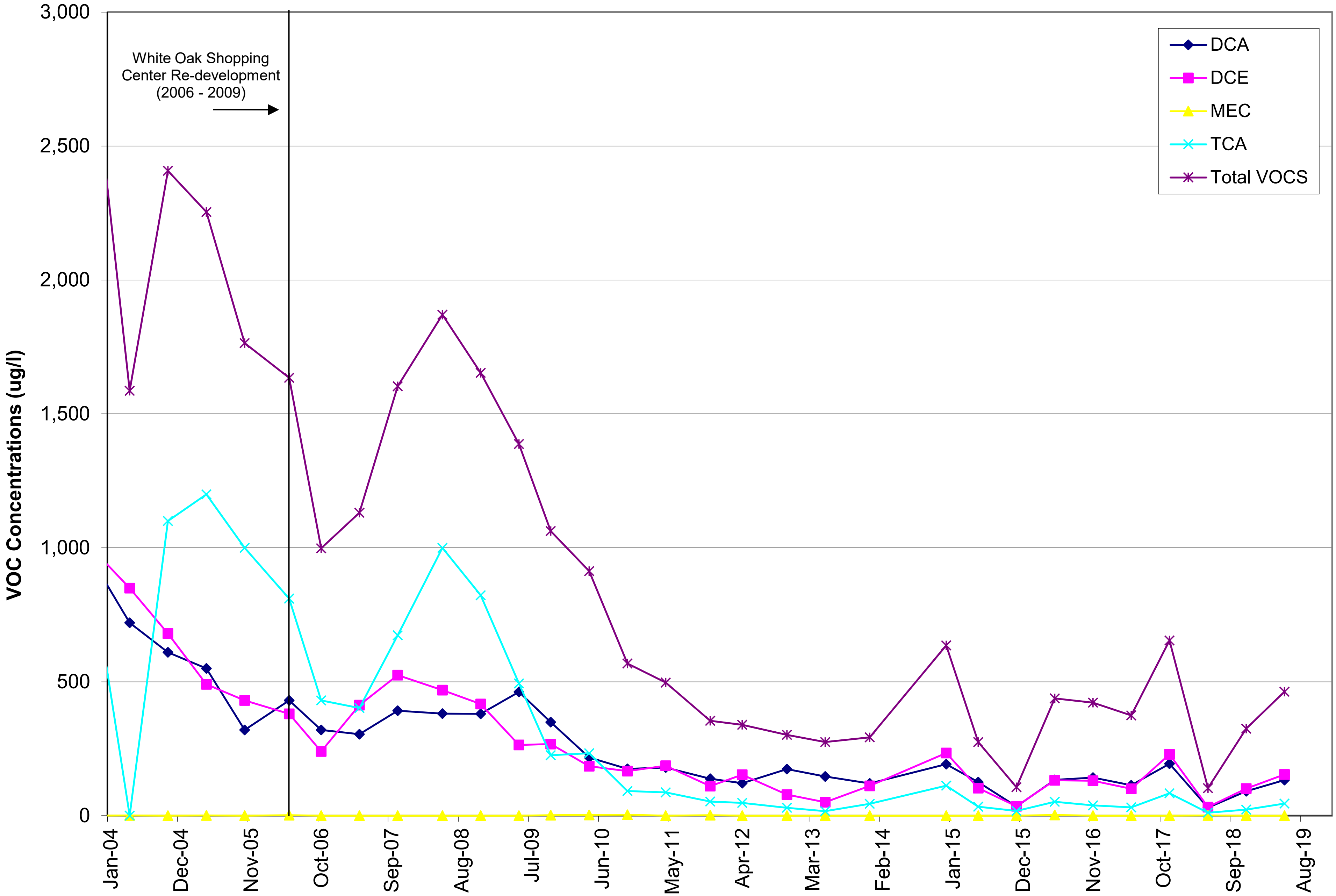


Figure 9
Total VOCs at MW17
Former AT&T Richmond Works Facility

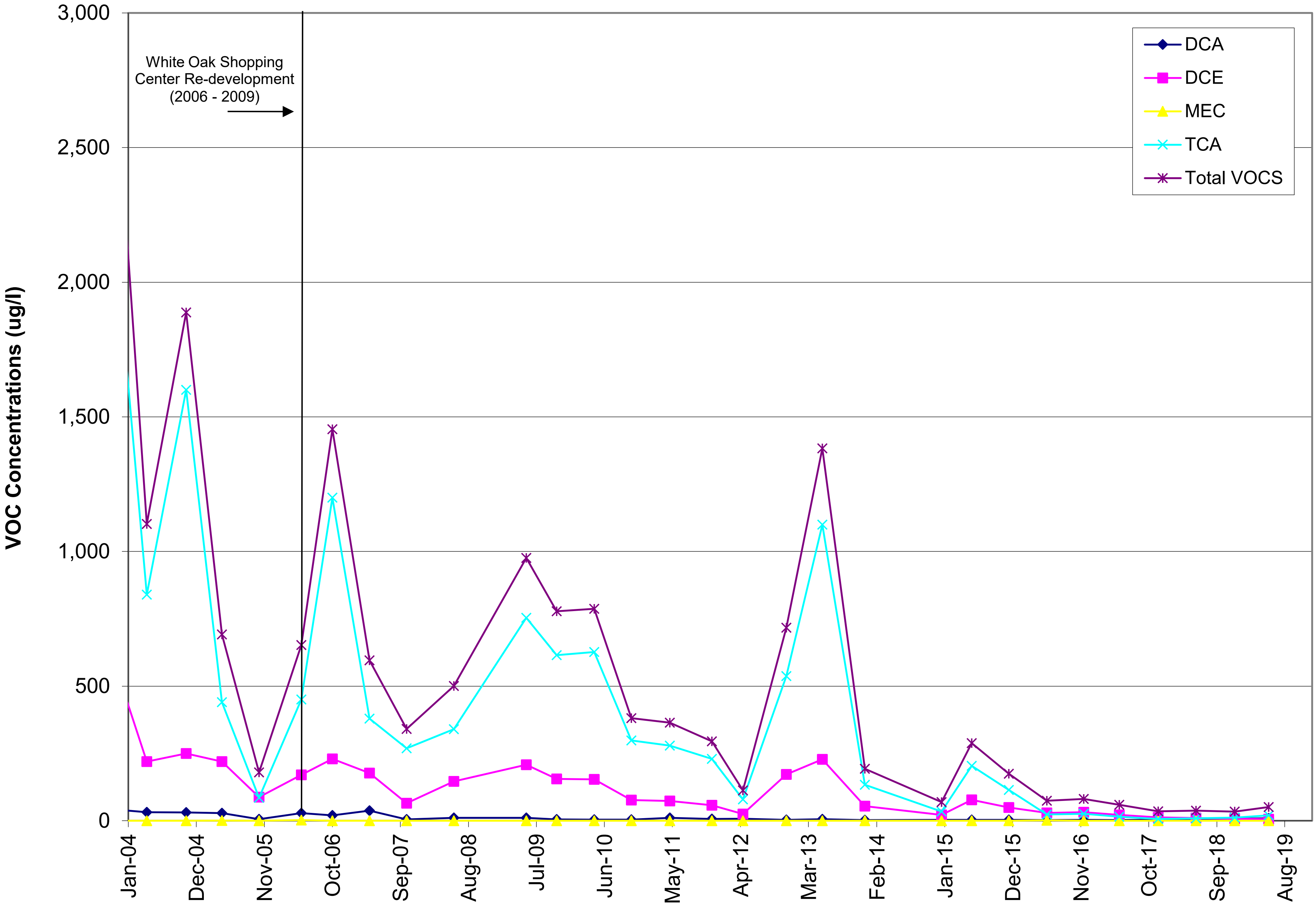
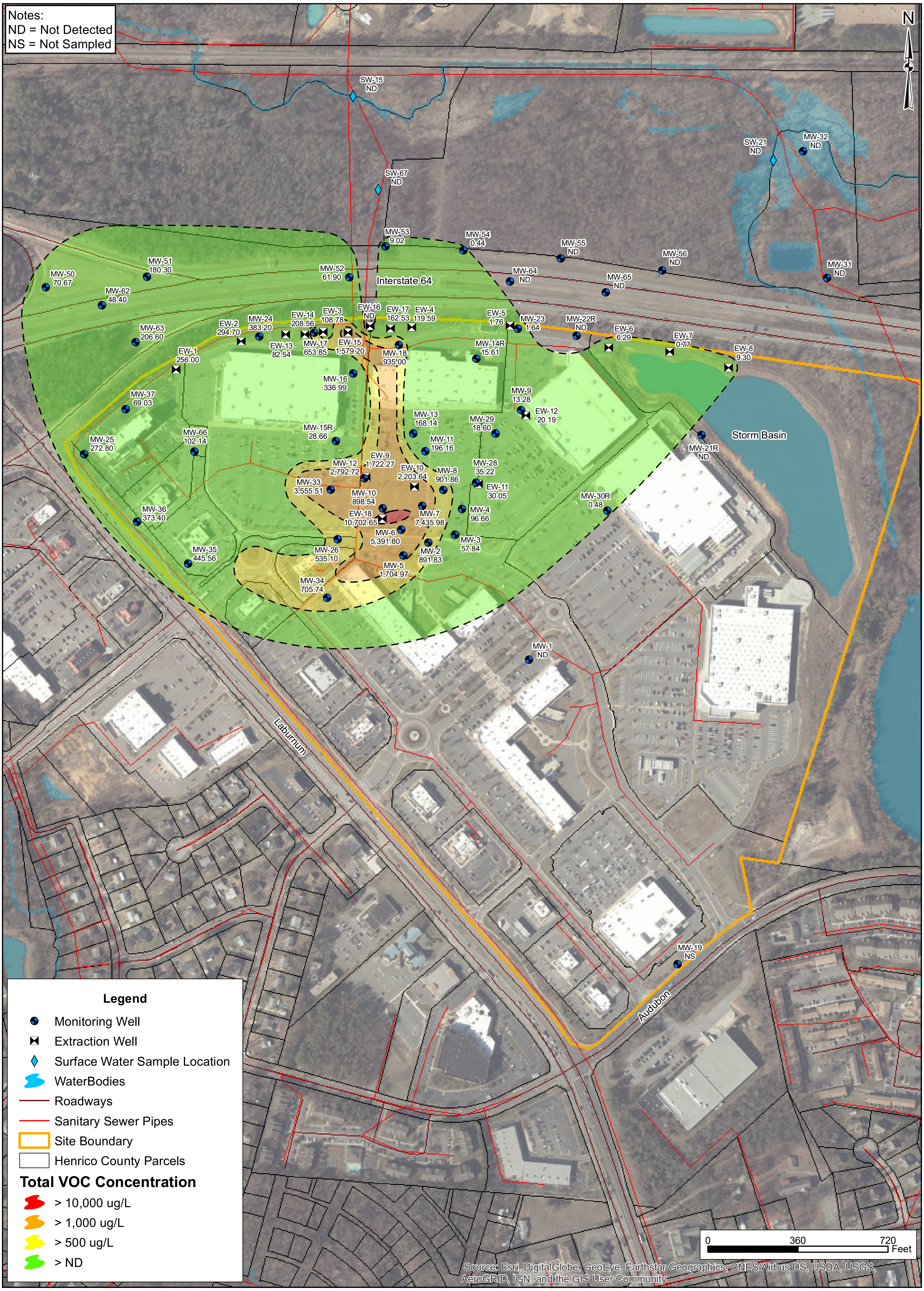


Figure 10
Total VOCs at MW28
Former AT&T Richmond Works Facility



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SITE:

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(919) 381-9900

TITLE:

NOVEMBER 2017
TOTAL VOCS

SCALE: 1 " = 360 ' | **DATE:** 12/22/2017 | **PROJECT:** 6480166010

DRAWN BY: D.Young | **CHECKED BY:** S. Knox

LOCATION: P:\Comm-Ind\Projects\Clients G to L\LSI Richmond\6480166010\GIS\Nov 2017

Figure:
11

wood.

SITE:

LSI CORPORATION
Former Lucent Richmond Works
4500 Laburnum Ave., Richmond, VA

CLIENT:

BROADCOM INC.

Wood Environment & Infrastructure Solutions, Inc.
4021 Stirrup Creek Drive, Suite 100
Durham, NC 27703
(919) 381-9900

TITLE:

MAY 2018
TOTAL VOCS

SCALE: 1 " = 360 '	DATE: 06/08/2018	PROJECT: 6480181003
DRAWN BY: D.Young	CHECKED BY: S. Knox	

LOCATION: P:\Comm-Ind\Projects\Clients G to L\LSI Richmond\6480181003\GIS\May 2018

Figure:

12

wood.

SITE:

LSI CORPORATION
Former Lucent Richmond Works
4500 Laburnum Ave., Richmond, VA

CLIENT:

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Wood Environment & Infrastructure Solutions, Inc.
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Durham, NC 27703
(919) 381-9900

TITLE:

NOVEMBER 2018
TOTAL VOCS

Figure: 13

SCALE: 1 " = 360 '	DATE: 01/08/2019	PROJECT: 6480181003
DRAWN BY: D.Young	CHECKED BY: S. Knox	

LOCATION: P:\Comm-Ind\Projects\Clients G to L\LSI Richmond\6480181003 Start Jan 2018\GIS\Nov 2018

Notes:
Samples from abandoned temporary monitoring wells collected during 2018 soil assessment activities.
ND = Not Detected
NS = Not Sampled
* = Acetone was detected in SW-21, but was likely introduced from laboratory processing and is not representative of environmental impacts.

wood.

SITE:

LSI CORPORATION
Former Lucent Richmond Works
4500 Laburnum Ave., Richmond, VA

CLIENT:

BROADCOM INC.

Wood Environment & Infrastructure Solutions, Inc.
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Durham, NC 27703
(919) 381-9900

TITLE:

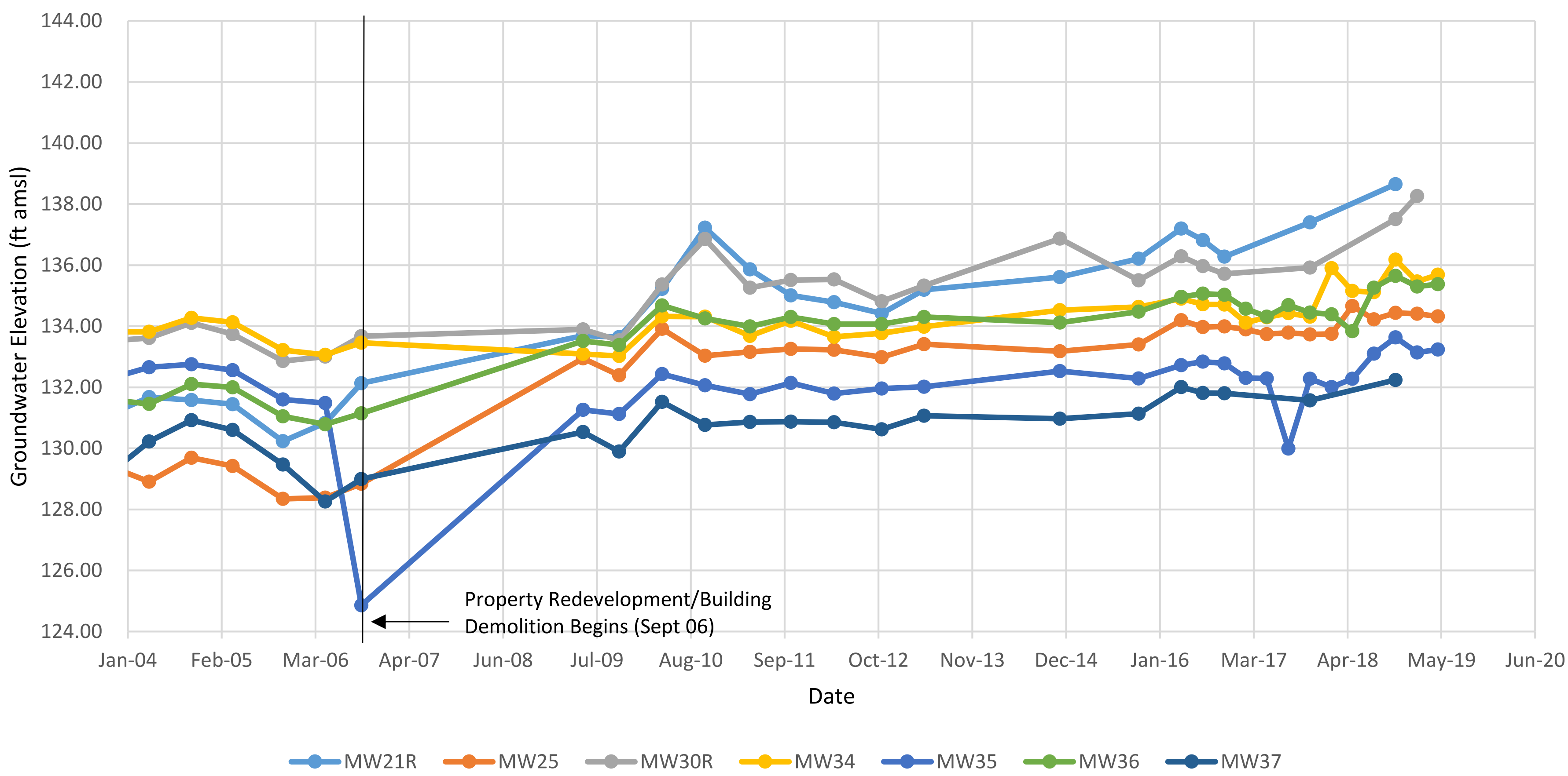
MAY 2019
TOTAL VOCS

Figure: 14

SCALE: 1 " = 360 '	**DATE:** 06/04/2019	**PROJECT:** 6480199002
DRAWN BY: D.Young	**CHECKED BY:** S. Knox	

LOCATION: \\dhm-fs1\projects\Comm-Ind\Projects\Clients G to L\LSI Richmond\6480199002 Start Jan 2019\07_CADD and GIS\May 2019

Figure 15
Background Well Hydrograph
Former AT&T Richmond Works Facility



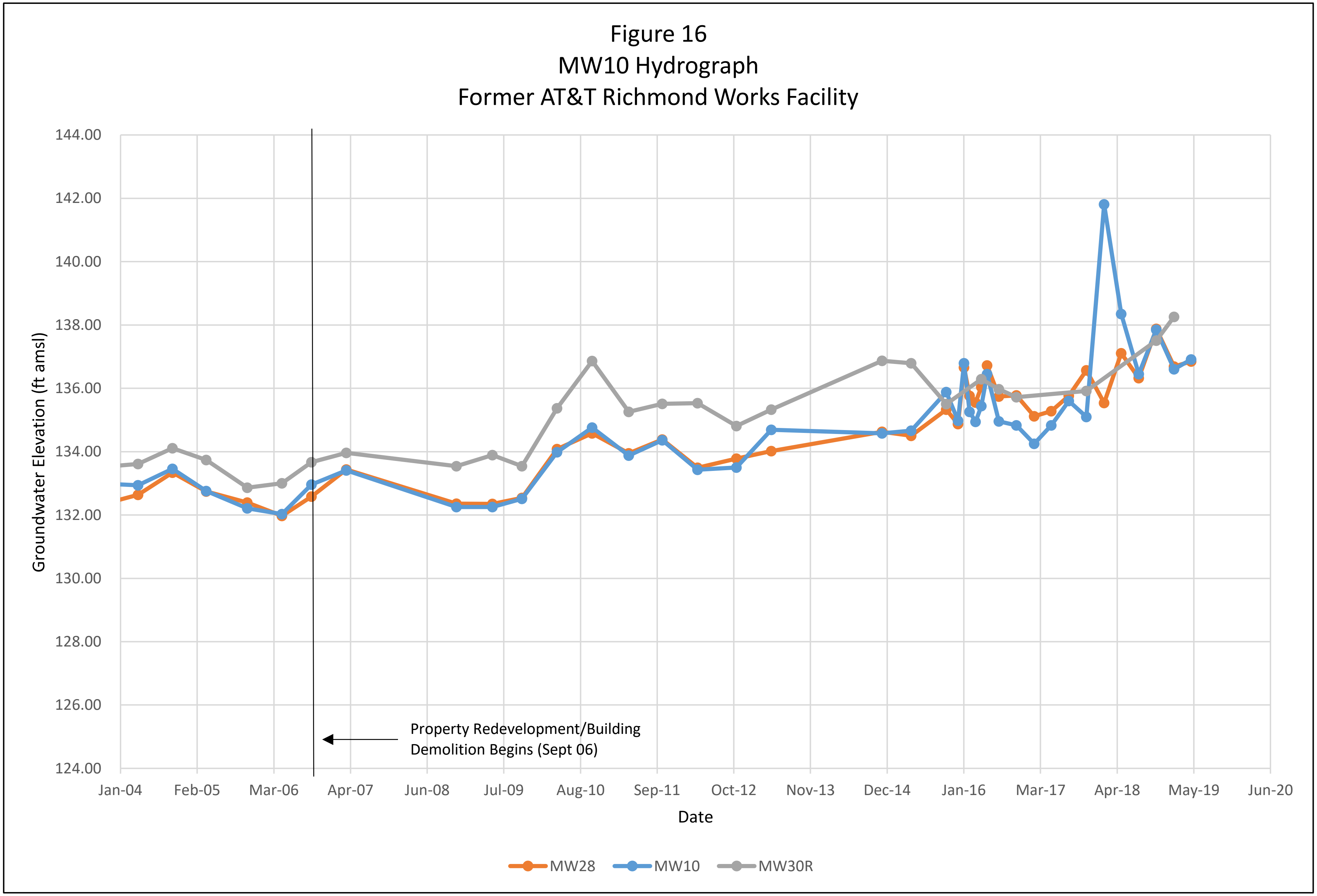


Figure 16
MW10 Hydrograph
Former AT&T Richmond Works Facility
Groundwater Elevation (ft amsl)
144.00
142.00
140.00
138.00
136.00
134.00
132.00
130.00
128.00
126.00
124.00
Property Redevelopment/Building
Demolition Begins (Sept 06)
Jan-04
Feb-05
Mar-06
Apr-07
Jun-08
Jul-09
Aug-10
Sep-11
Oct-12
Nov-13
Dec-14
Jan-16
Mar-17
Apr-18
May-19
Jun-20
Date
MW28
MW10
MW30R

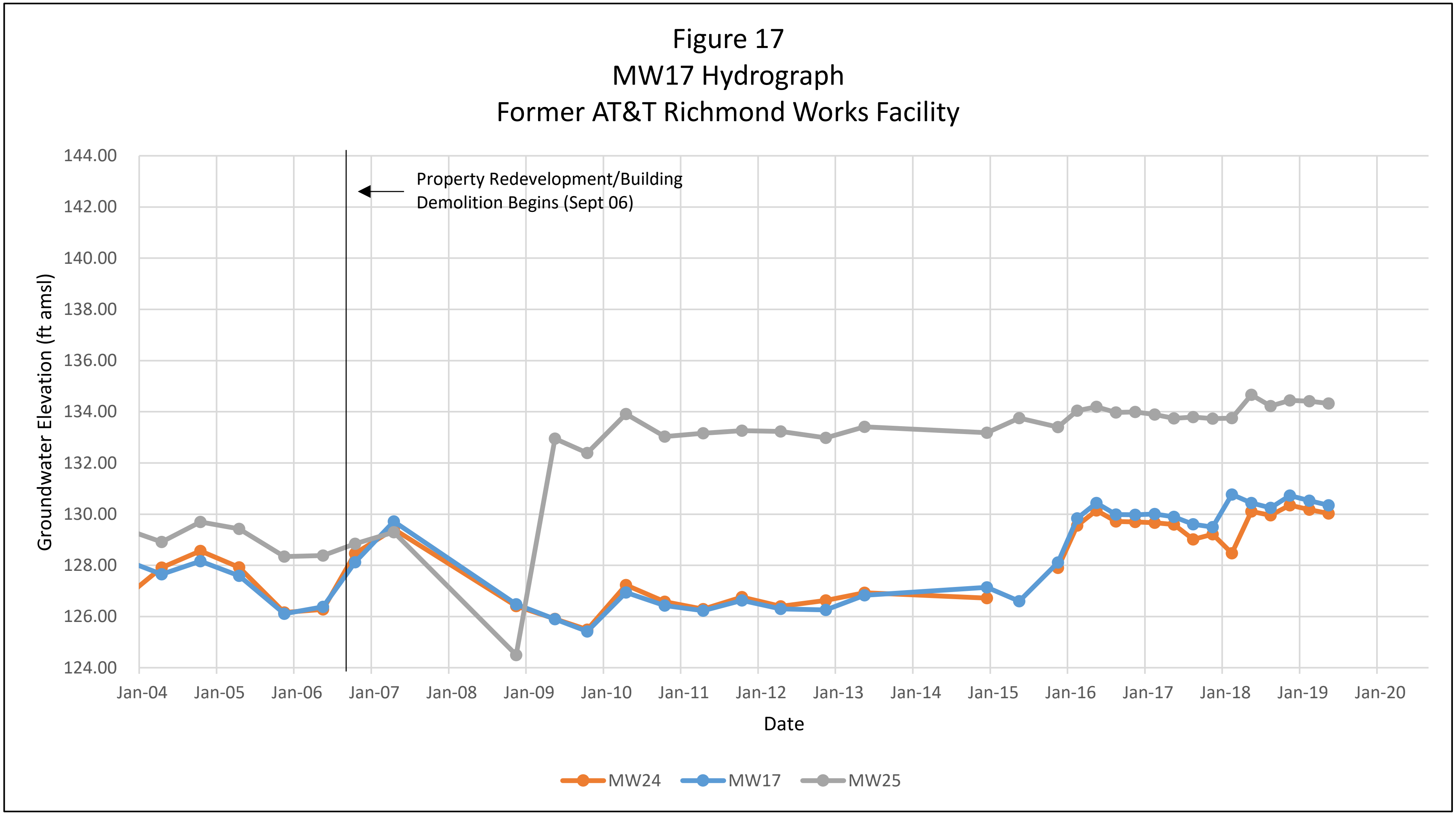


Figure 17
MW17 Hydrograph
Former AT&T Richmond Works Facility
Property Redevelopment/Building
Demolition Begins (Sept 06)
Groundwater Elevation (ft amsl)
144.00
142.00
140.00
138.00
136.00
134.00
132.00
130.00
128.00
126.00
124.00
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Date
MW24
MW17
MW25

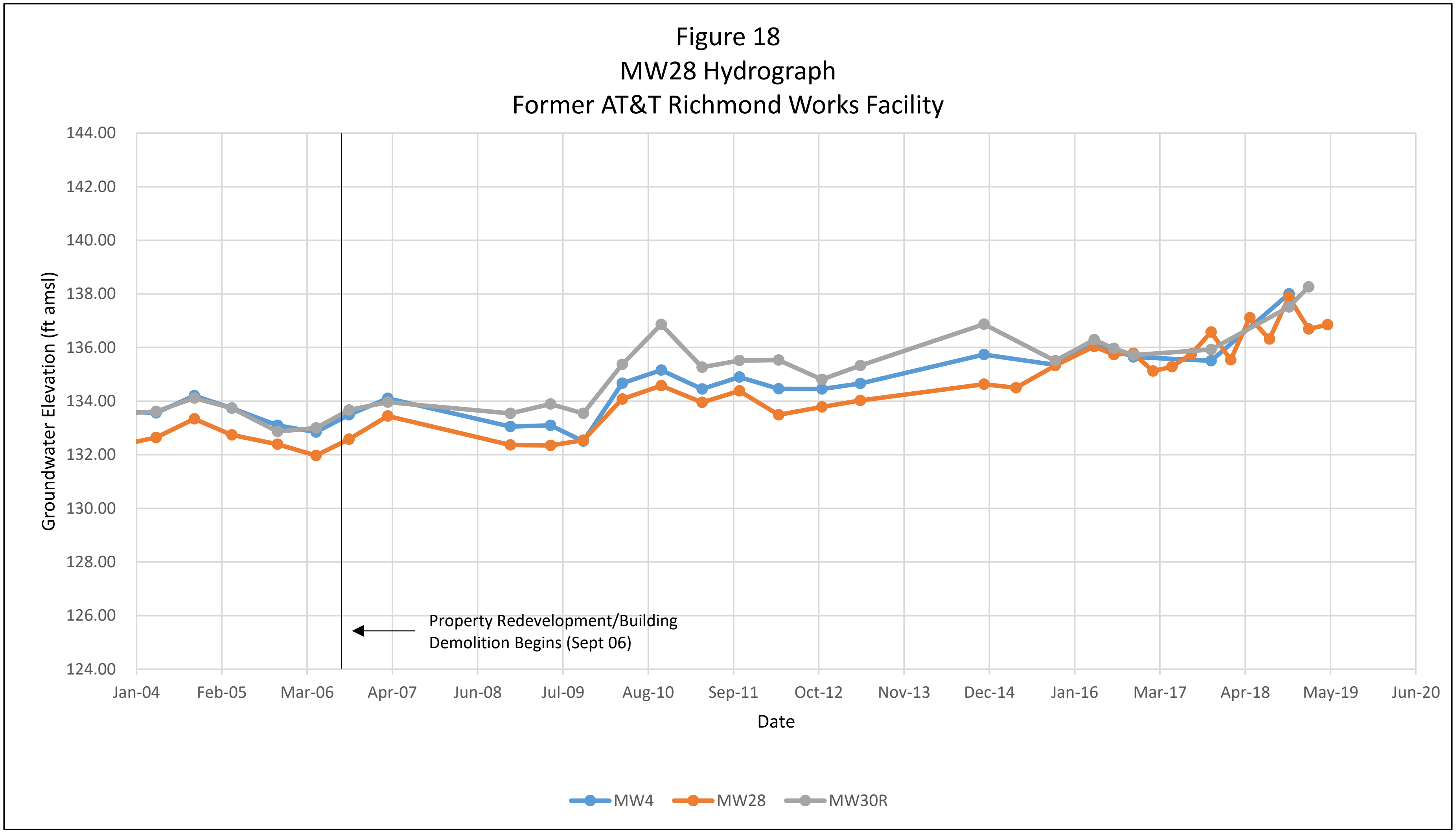


Figure 18
MW28 Hydrograph
Former AT&T Richmond Works Facility
144.00
142.00
140.00
138.00
136.00
134.00
132.00
130.00
128.00
126.00
124.00
Groundwater Elevation (ft amsl)
Property Redevelopment/Building
Demolition Begins (Sept 06)
Jan-04
Feb-05
Mar-06
Apr-07
Jun-08
Jul-09
Aug-10
Sep-11
Oct-12
Nov-13
Dec-14
Jan-16
Mar-17
Apr-18
May-19
Jun-20
Date
MW4
MW28
MW30R

APPENDIX A

Historical Information

APPENDIX B

Boring Logs

APPENDIX C

Analytical Summary Table for Each Sampling Event

APPENDIX D

Historical Data Summary Tables & VOC Trend Graphs

APPENDIX E

Historical Groundwater Potentiometric Surface Maps

APPENDIX F

Mann-Kendall Graphs

APPENDIX G

Laboratory Data & Validation Reports

APPENDIX H

Historical Isoconcentration Maps